Forest Research

Long term trends and effects of air pollution on British forests and soils

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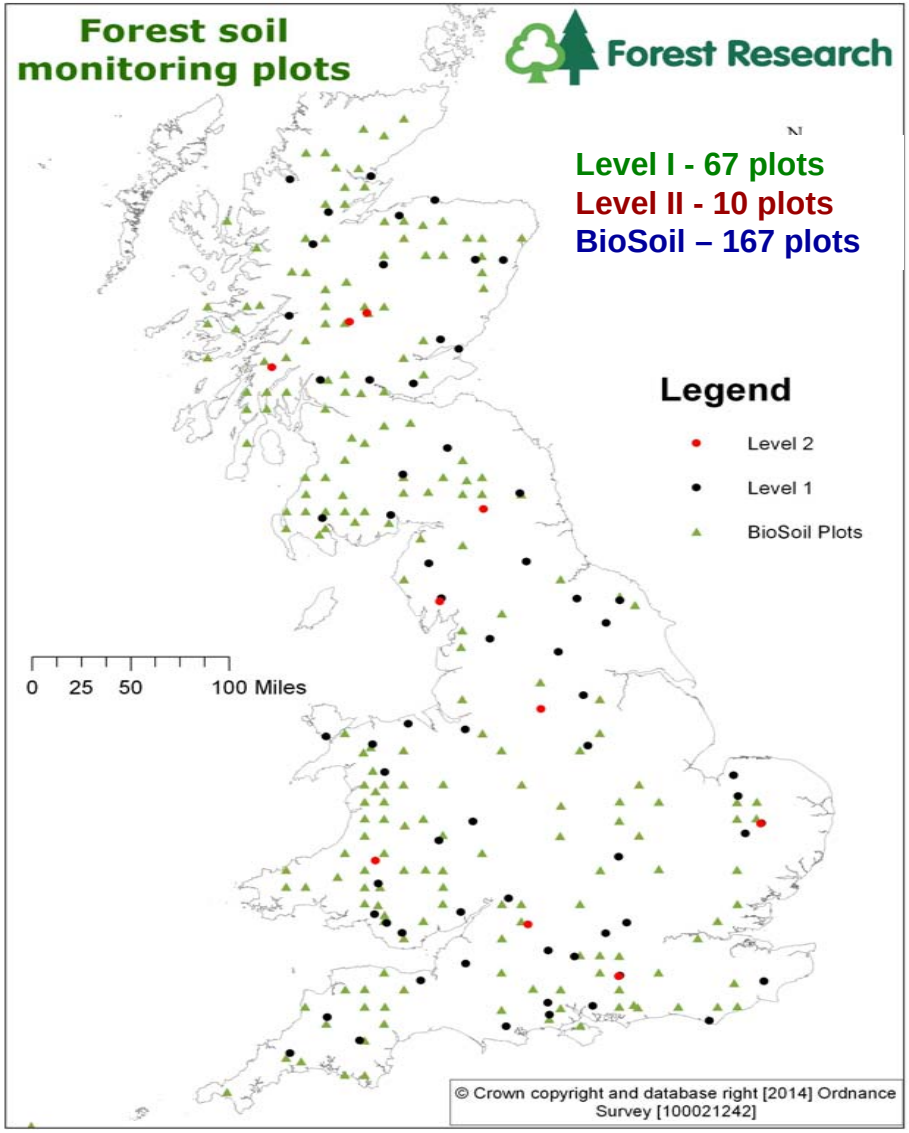
Forest Research, UK

Extensive and Intensive ICP forest monitoring networks



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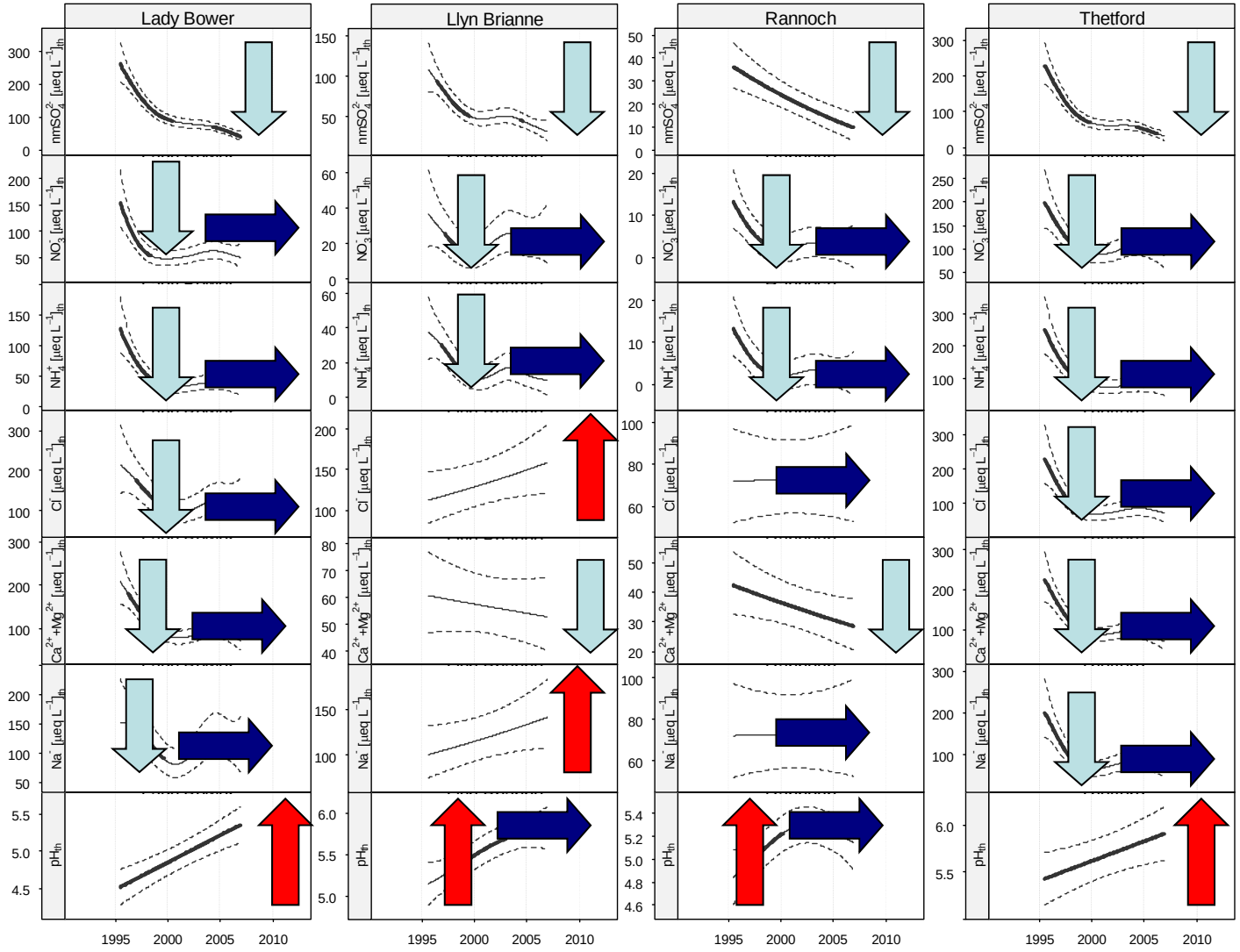
Deposition chemistry - conifer sites Level II sites



SO_4

NO_3

NH_4

Cl

Ca

Na

pH

Sawicka et al. submitted

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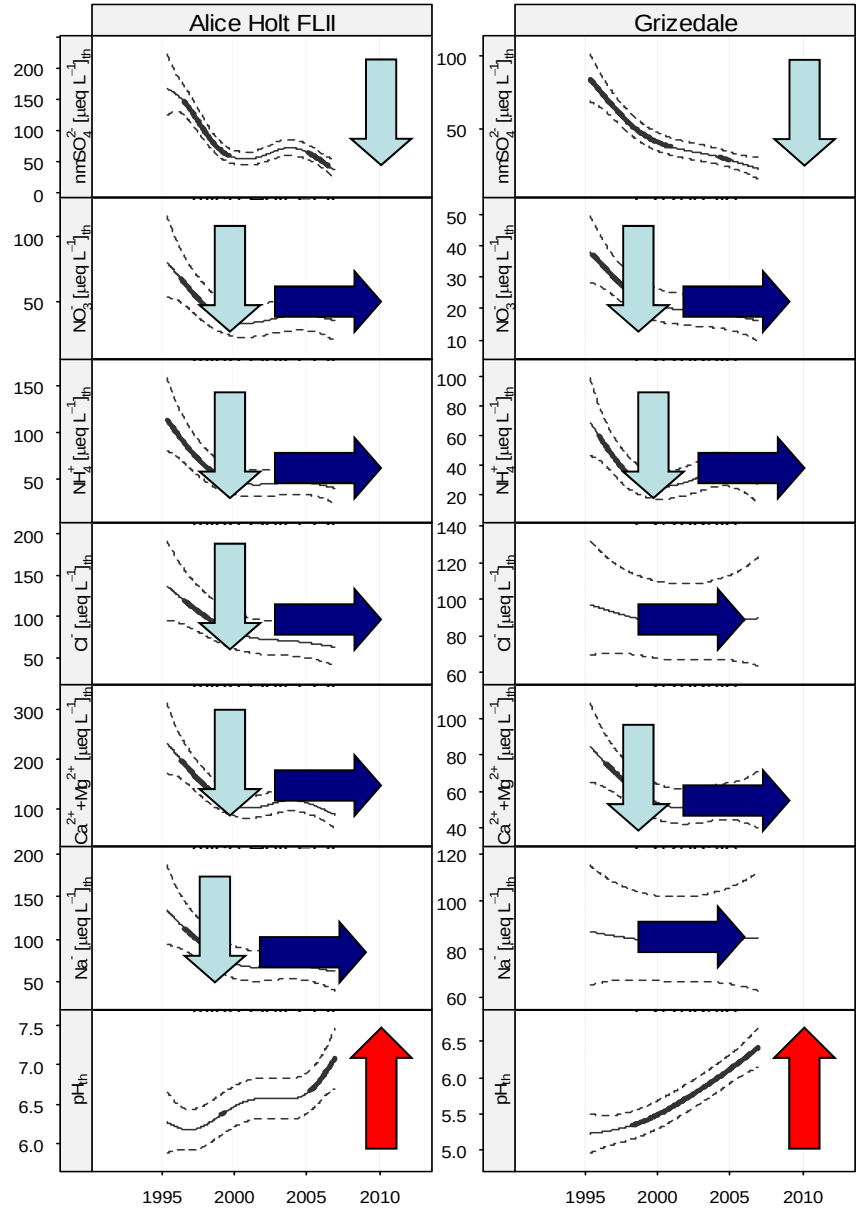

SO_4

NO_3

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Cl

Ca

Na

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Deposition chemistry
Broadleaved Level II sites

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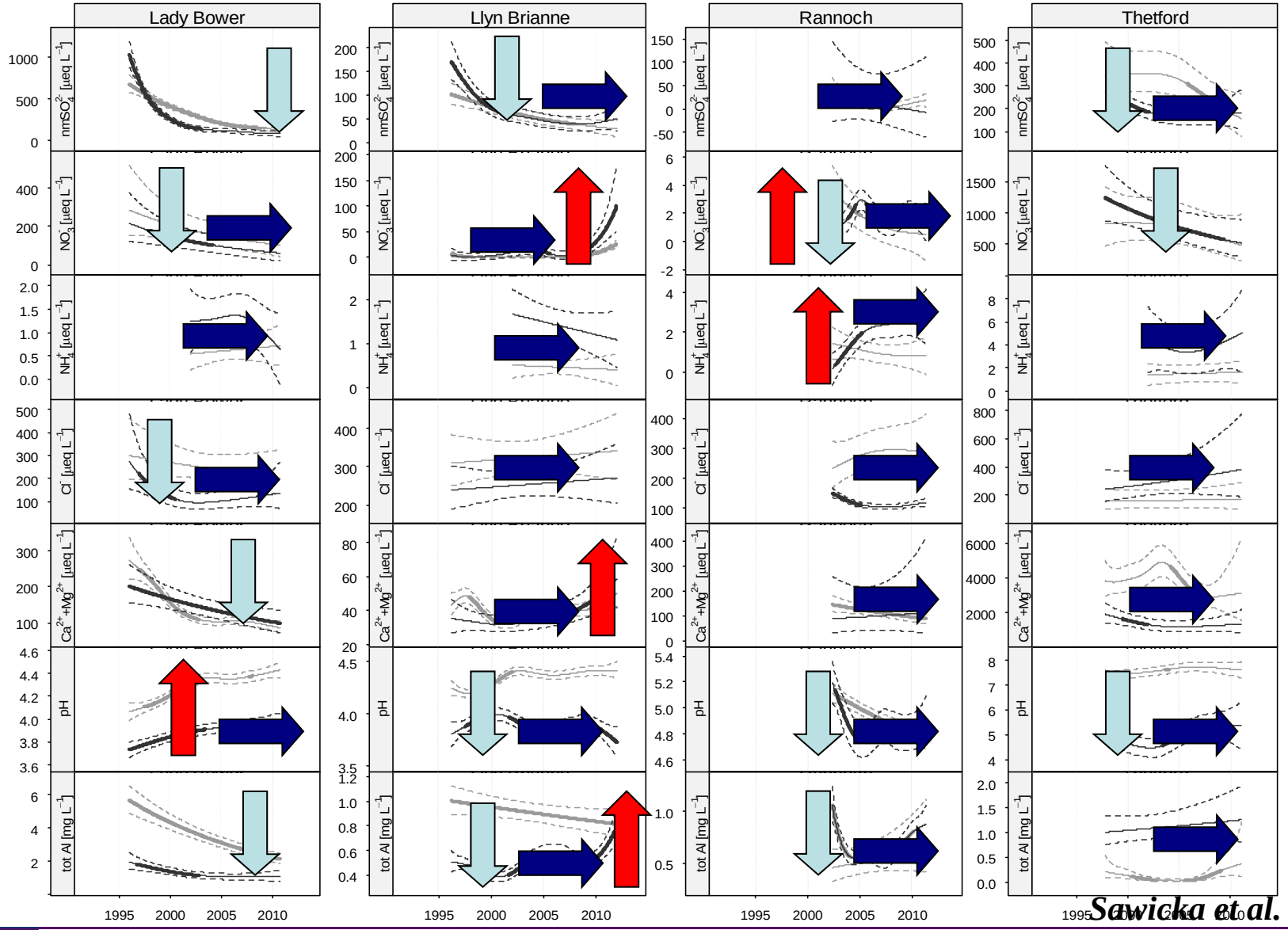
Soil solution – conifer Level II sites



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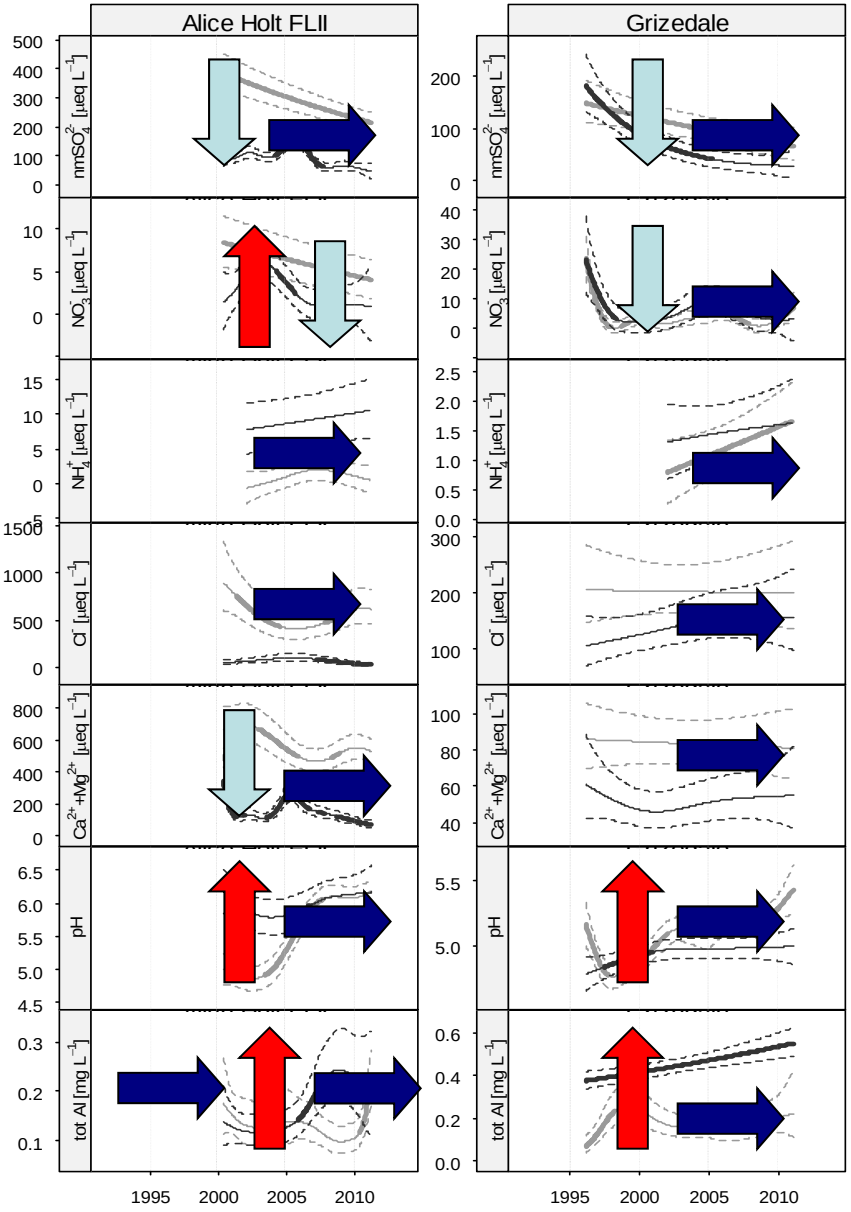

SO_4

NO_3

NH_4

Cl

Ca

pH

Al

Soil solution chemistry – Broadleaved Level II sites non linear modelling by generalised additive mixed models (GGMM's)

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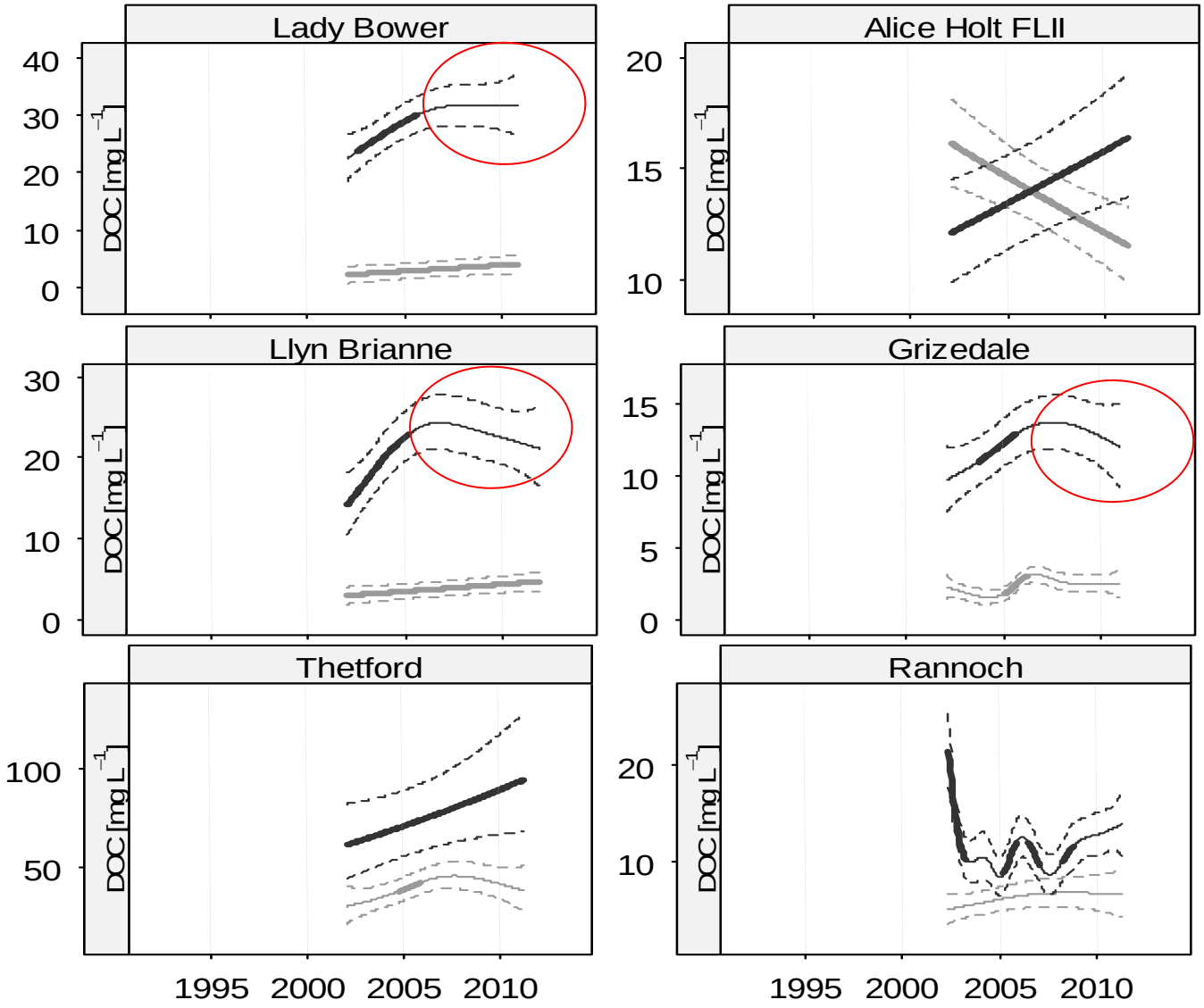

Soil solution DOC – by non -linear trends analysis

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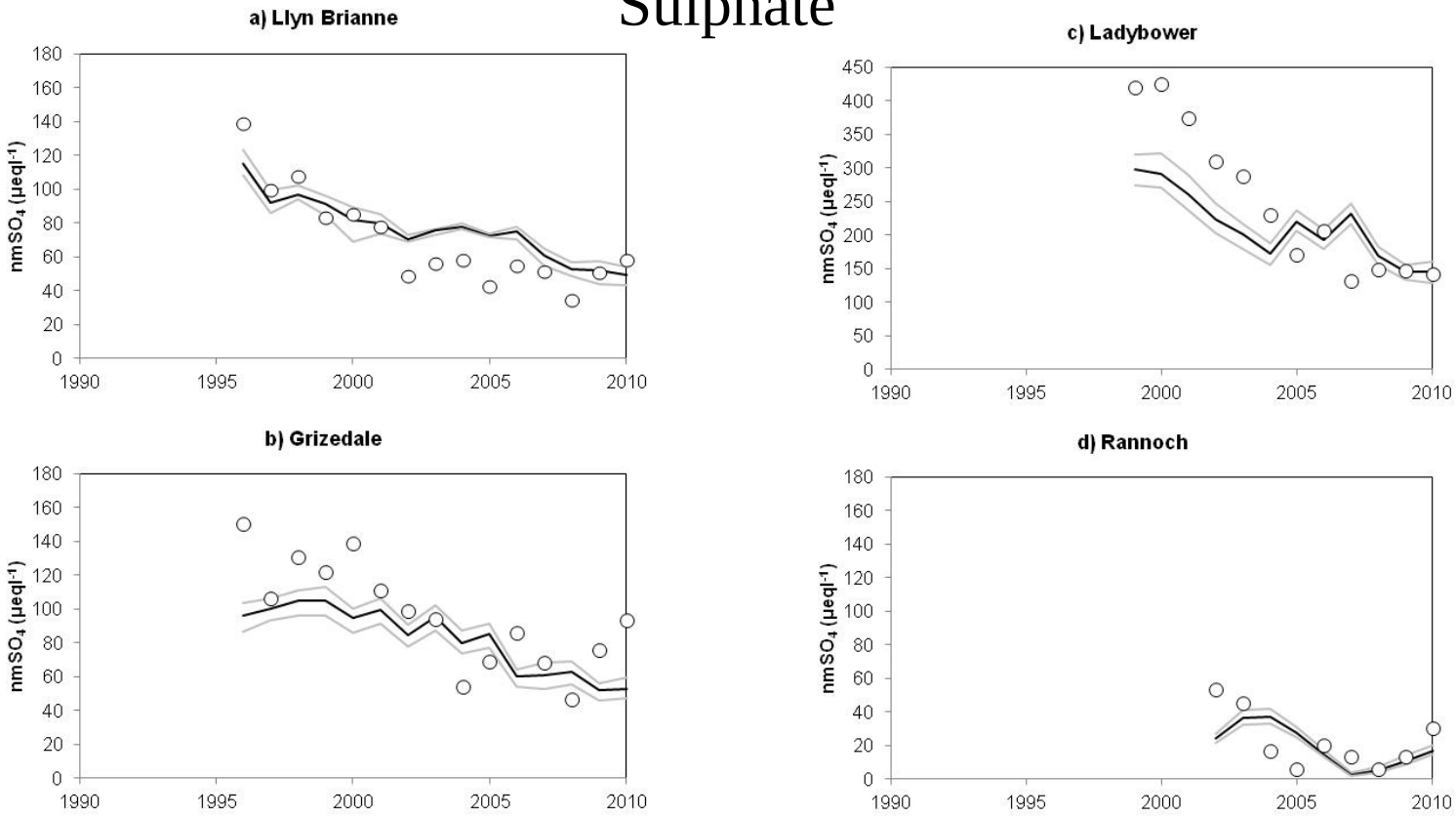
Model of Acidification of Groundwater in Catchments (MAGIC)

coupled to a Monte Carlo Markov Chain Bayesian calibration framework to constrain model predictions model simulations of soil solution chemistry and uncertainties

Sulphate



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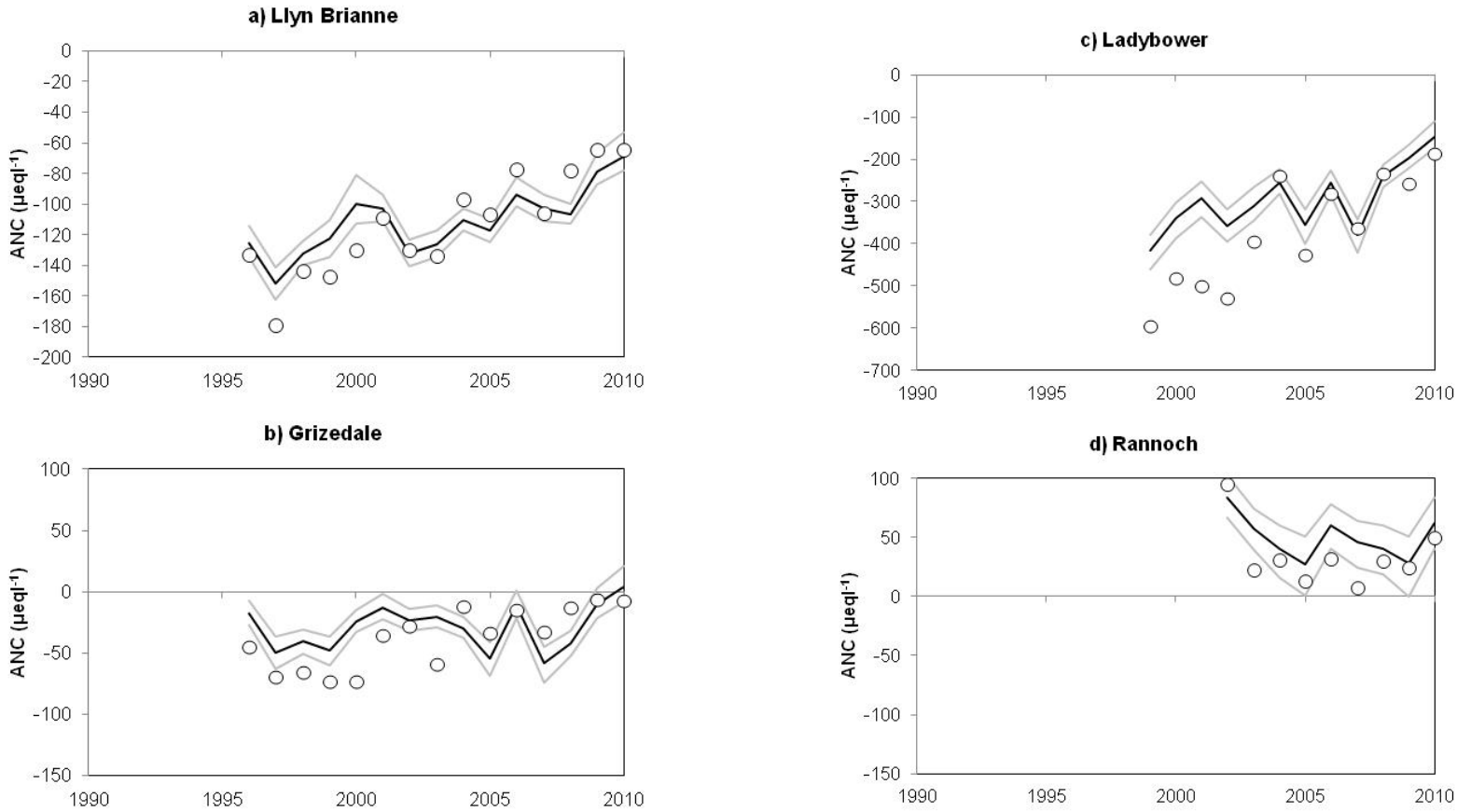
MAGIC model simulations of soil solution chemistry and uncertainties

ANC (Acid Nautralising Capacity)



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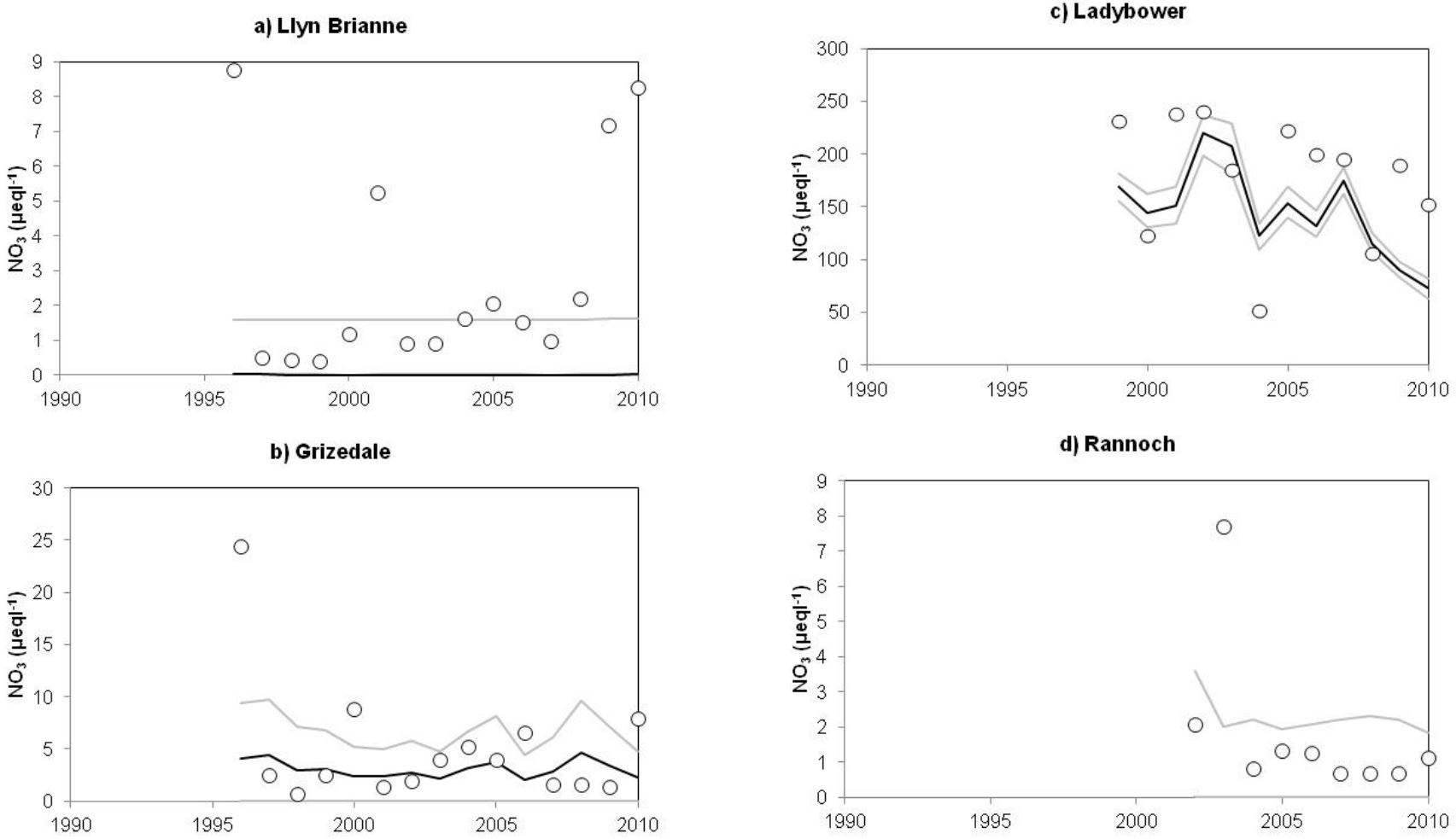
MAGIC model simulations of soil solution chemistry and uncertainties

Nitrate



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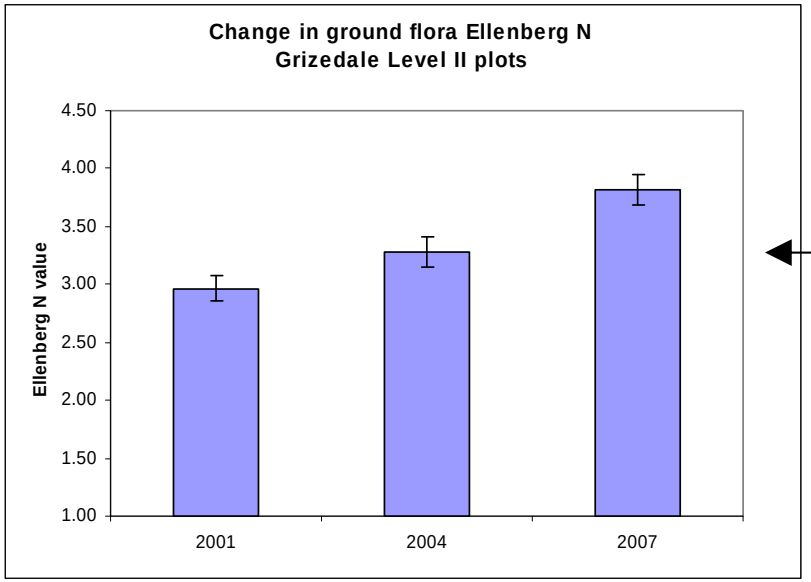
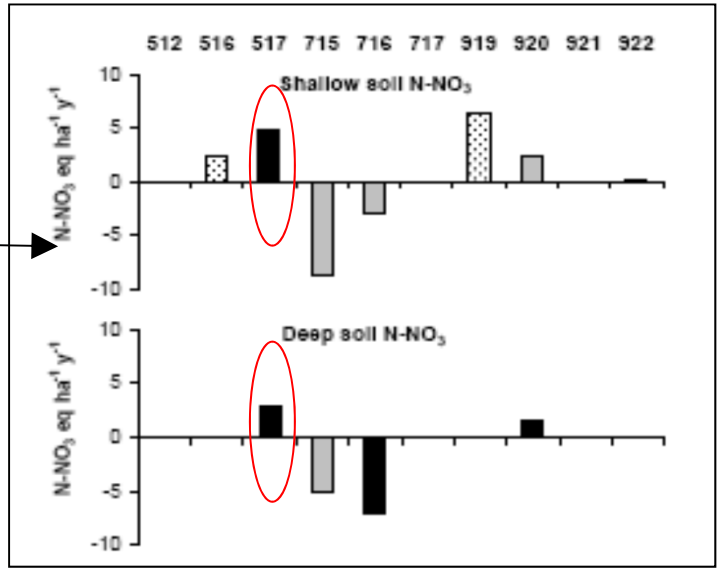
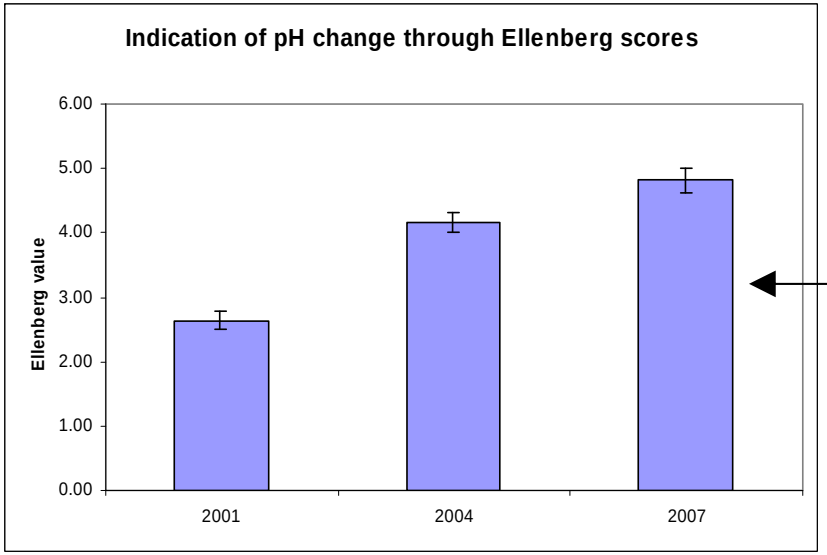
Indication of change in pH, N and light through Ellenberg values at Grizedale

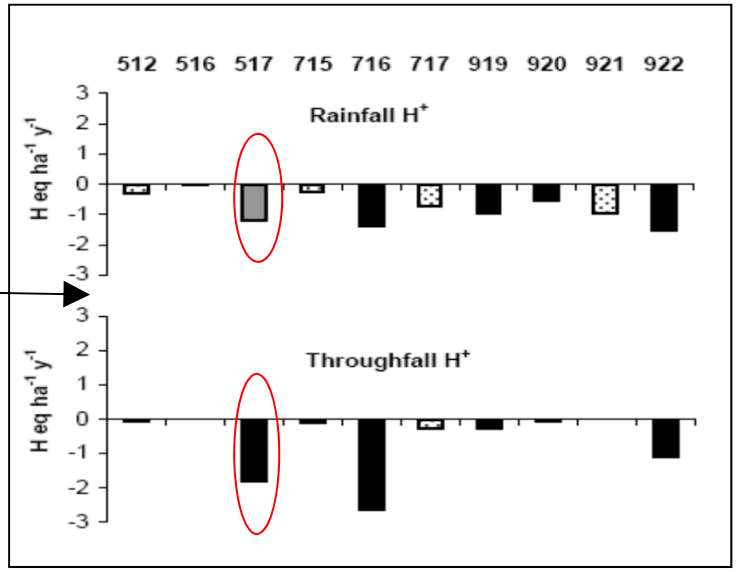


N





pH



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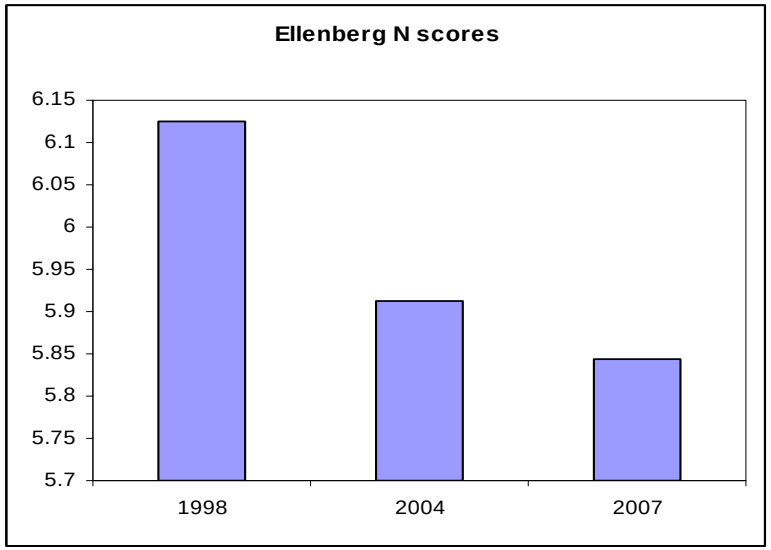
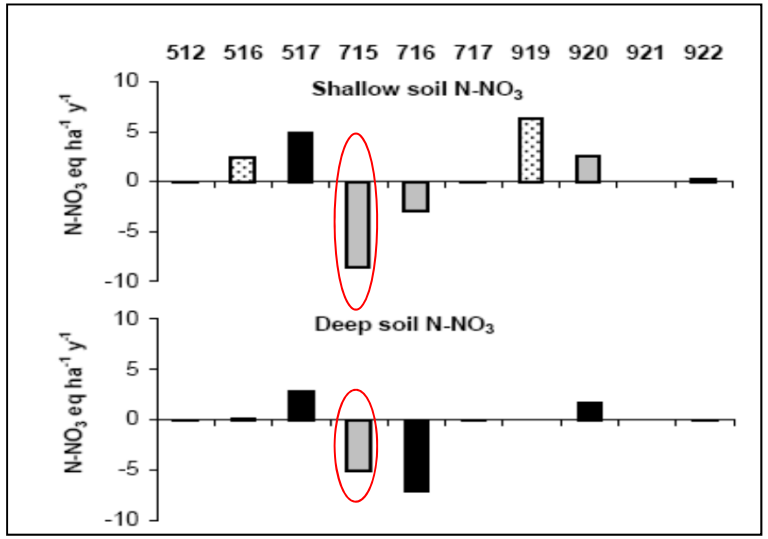
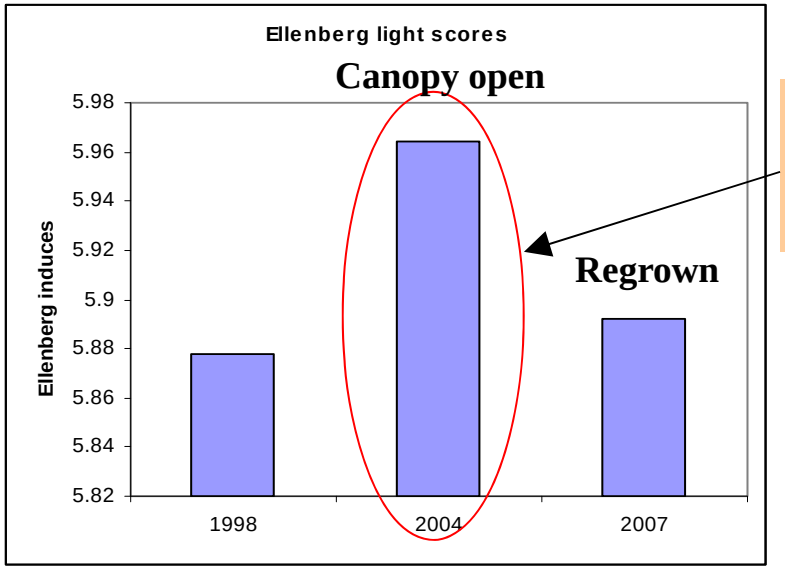
Indication of change in pH, N and light through Ellenberg values at Thetford



N

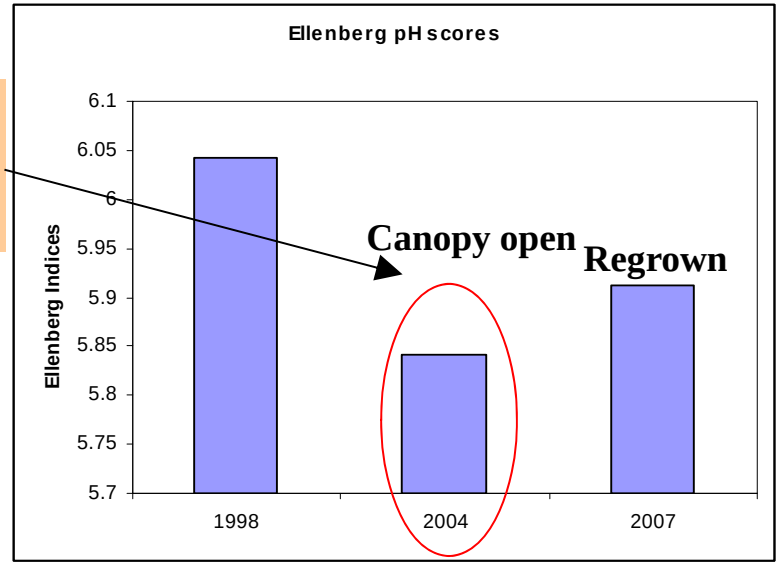
Notable increase in biodiversity 1998-2007





Thinning effect?

Decrease in bracken and increase of grasses



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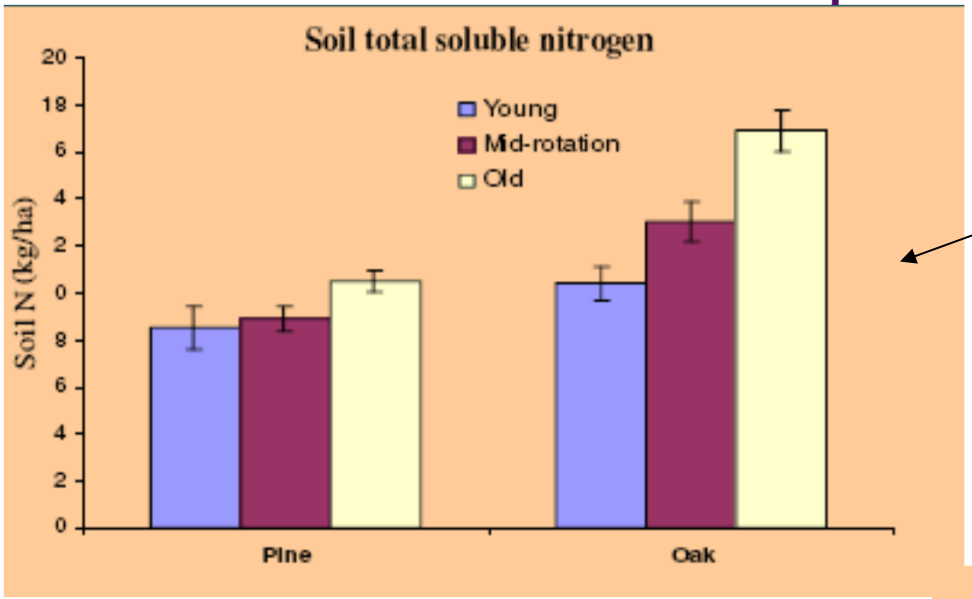
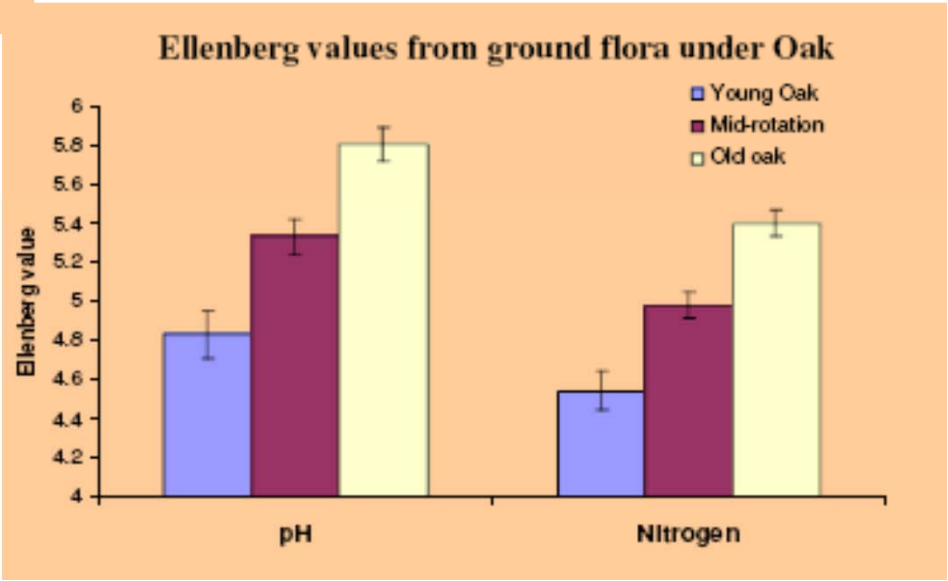
Ground flora and soil N and pH at the ECN sites - chronosequence study



Stand age effect on soil N could be misinterpret for pollution effect, especially comparing between young and old stands.



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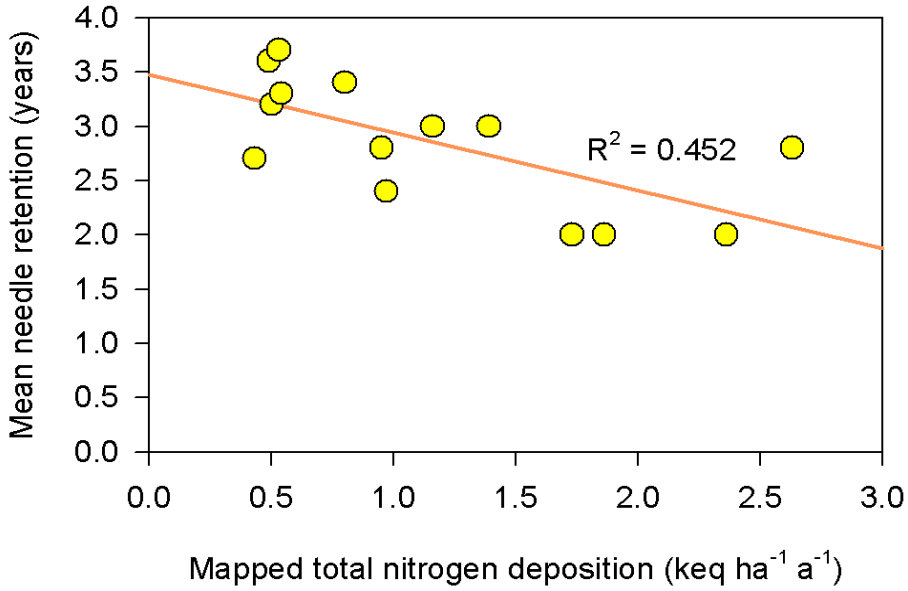

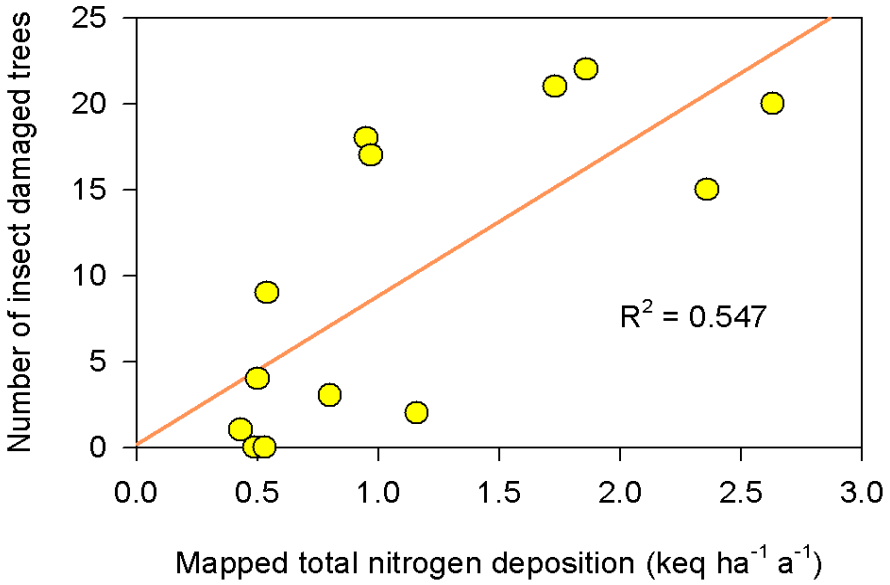

Observed relationships between forest condition and nitrogen deposition (Level I)

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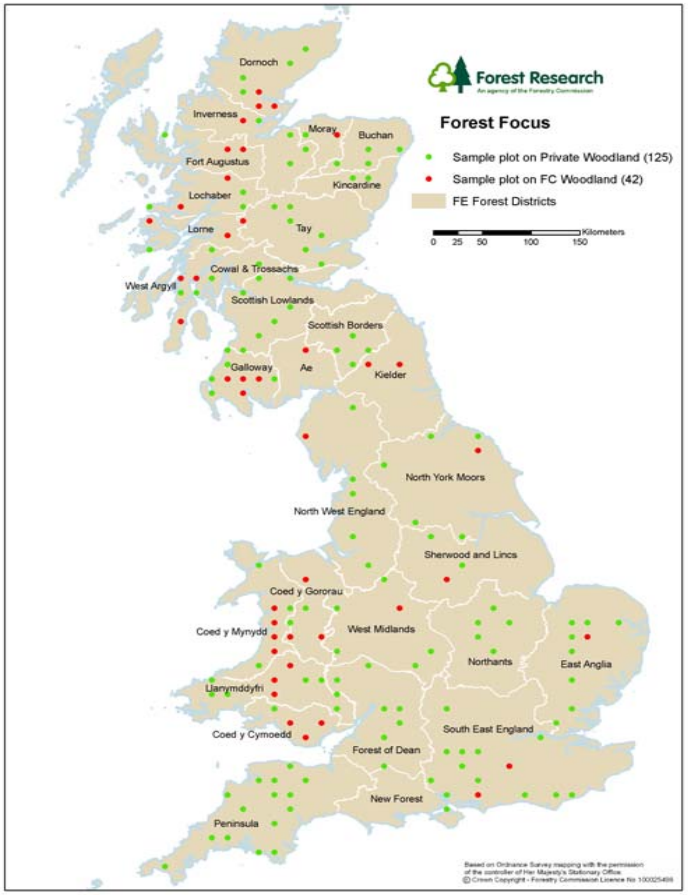
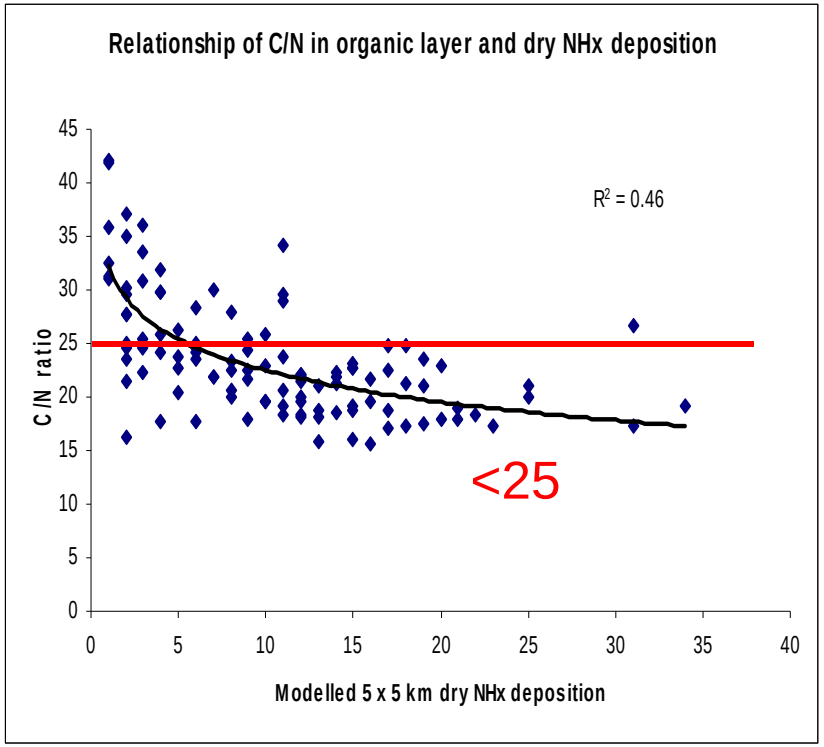
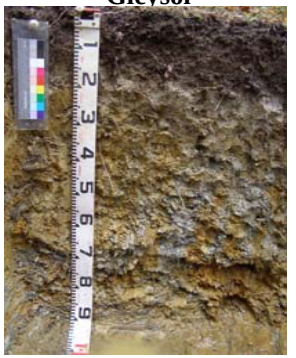
UK BioSoil plot locations - 167 plots





Podzol

Gleysol



Histosol

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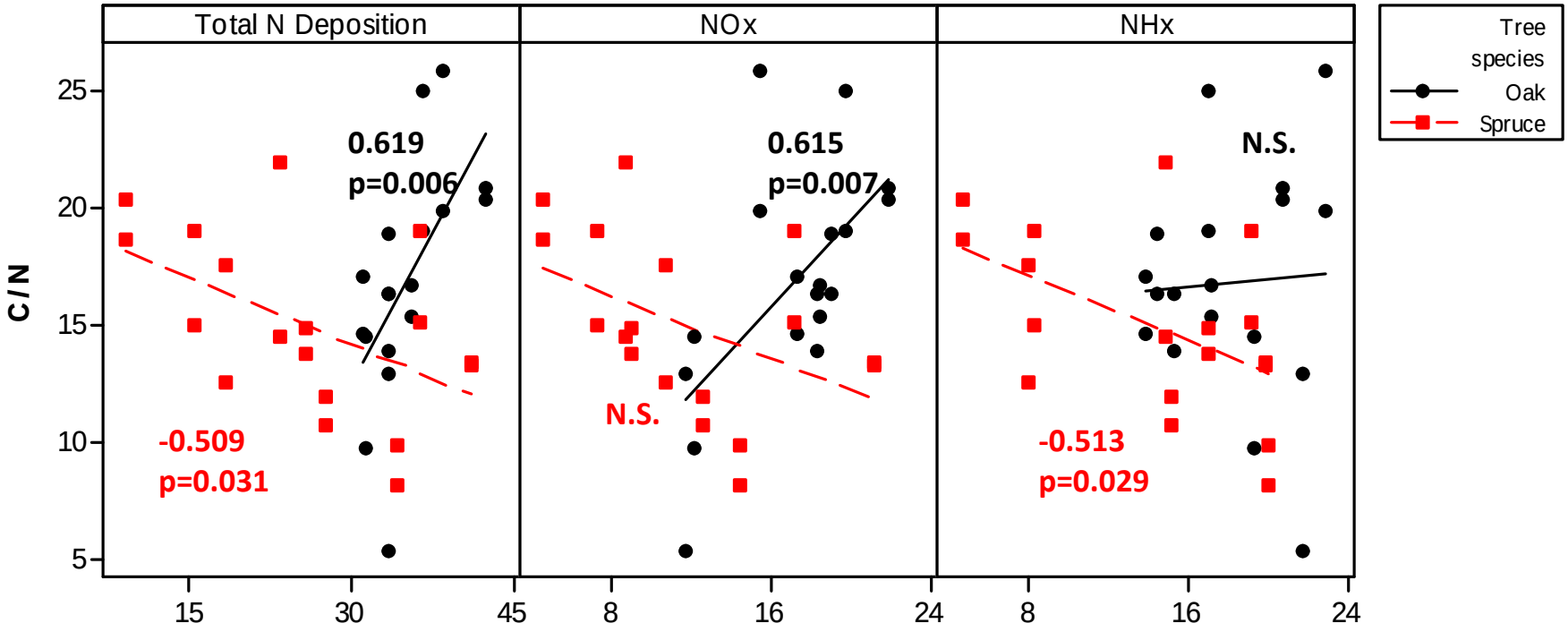
C/N ratio vs N Deposition (Species x soil effect)
A selection of BioSoil plots



NOx significant in broadleaved Oak
NHx significant in conifer, e.g. Sitka spruce
Oposite effect of N deposition on C/N ratio in different forest type?
What is the soil effect?
Positive relationship of C/N ratio soil IALF (inter agregate light fraction) with N deposition

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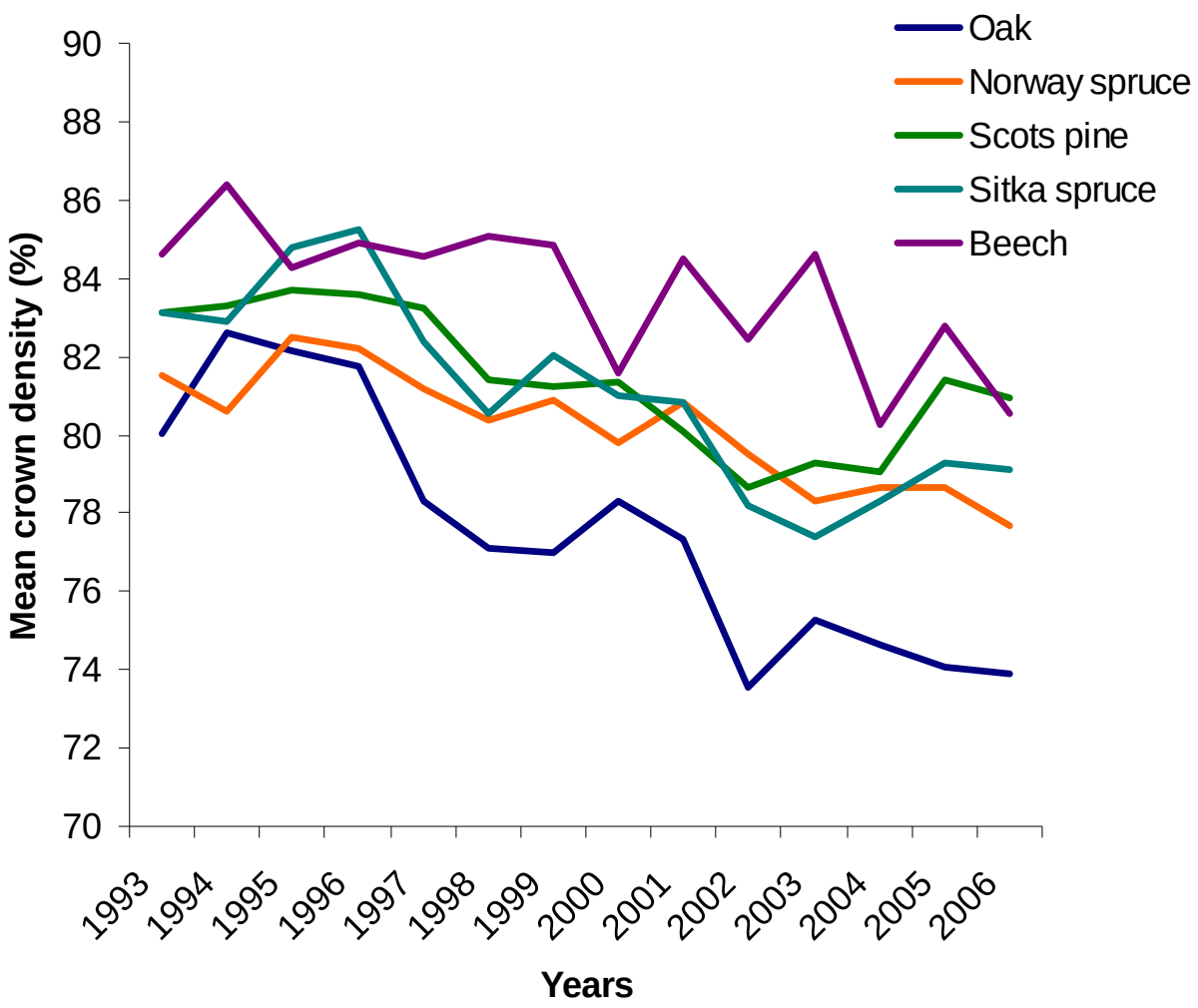
Level I crown condition in the UK



Oak

winter moth, tortrix, climate change (e.g. soil moisture)

Scots pine

fungi, insects

Sitka Spruce

green spruce aphid

Beech

masting, climate (e.g. soil moisture)

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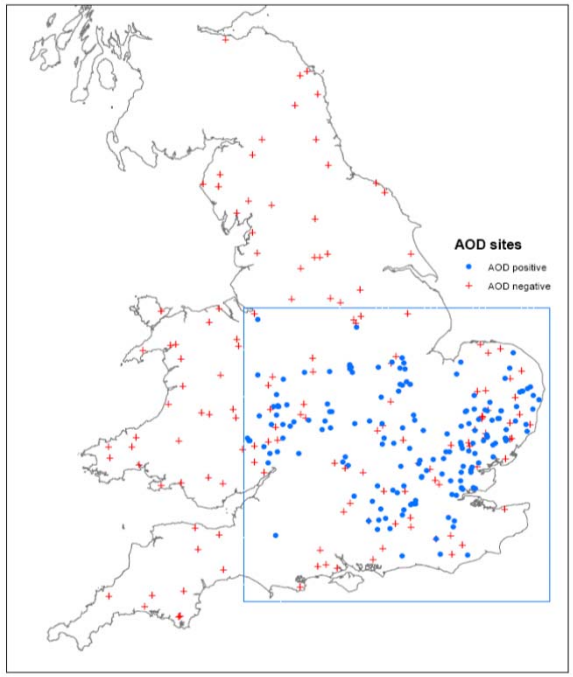
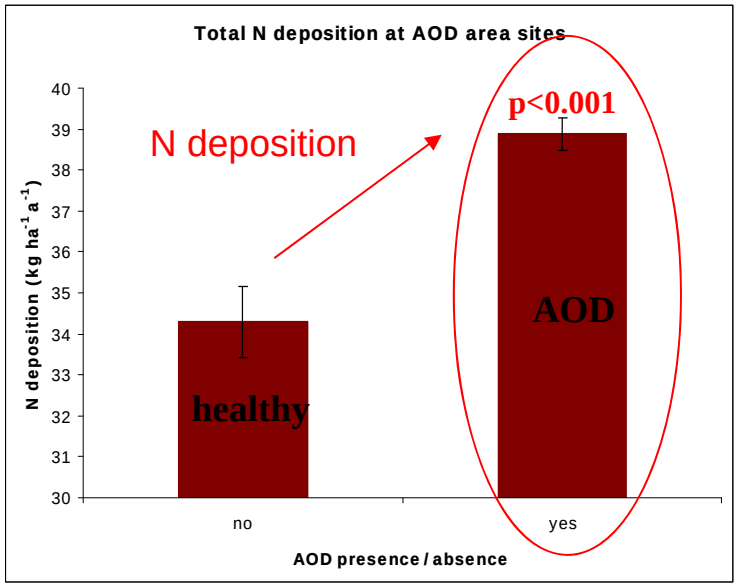
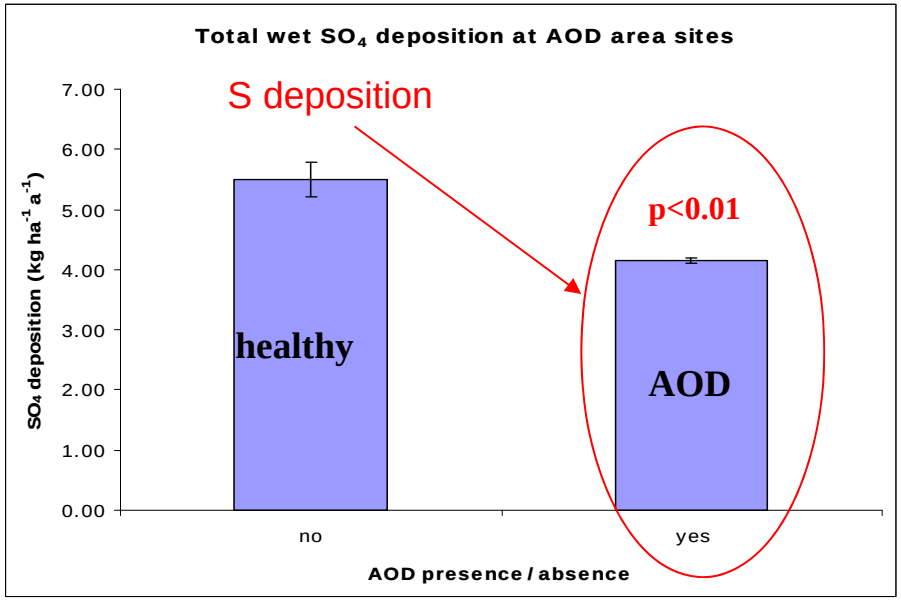




N deposition links with Acute Oak decline?

Anti-microbial effect from S?



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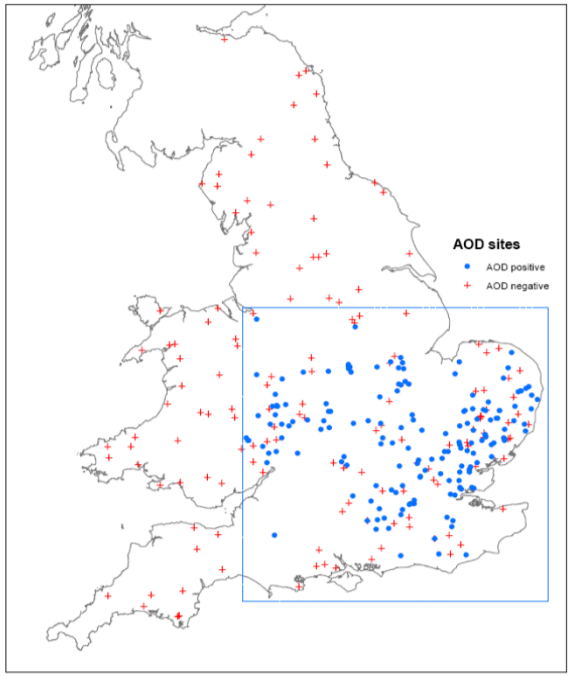
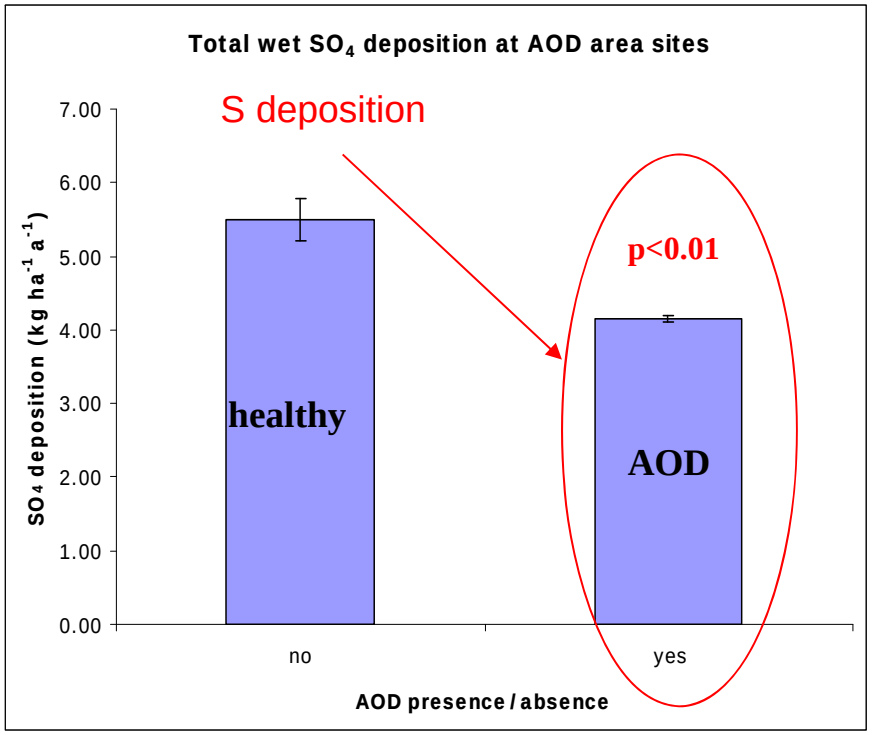


Anti-microbial effect from S?



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Conclusions

- **Long term trends in deposition chemistry and soil solution response are not monotonic and not linear**
- **Intensive monitoring indicates some recovery from acid deposition at previously polluted sites which is reflected already in ground flora and tree nutrition, e.g. foliar S, Al levels.**
- **Biological response to changes in air quality and deposition should take account the potential impact of forest management and forest ageing**
- **Concerns over the local effects of excess nitrogen deposition and its forms remain (edge effects) and future likelihood for nitrate release from forest soils.**
- **The N input is important predisposition factor for tree health and disease spread and it needs to be taken into account in the predictive modelling of tree health susceptibility and spatial spread of diseases.**
- Long term tree response to deposition and climate is investigated by growth and water use efficiency response – through dendrochronology and triple isotopes analysis – C, N and O

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