

Long-term and large-scale macronutrient modelling in semi-natural terrestrial ecosystems

Jessica Davies

Lancaster University, UK

Edward Tipping

CEH Lancaster, UK

Edwin Rowe

CEH Bangor, UK

John Boyle

University of Liverpool, UK

Elisabeth Graf-Pannatier

WSL Switzerland

Vegard Martinsen

NMBU Norway

What we need and what we have

For semi-natural terrestrial ecosystems in the UK:

NEED

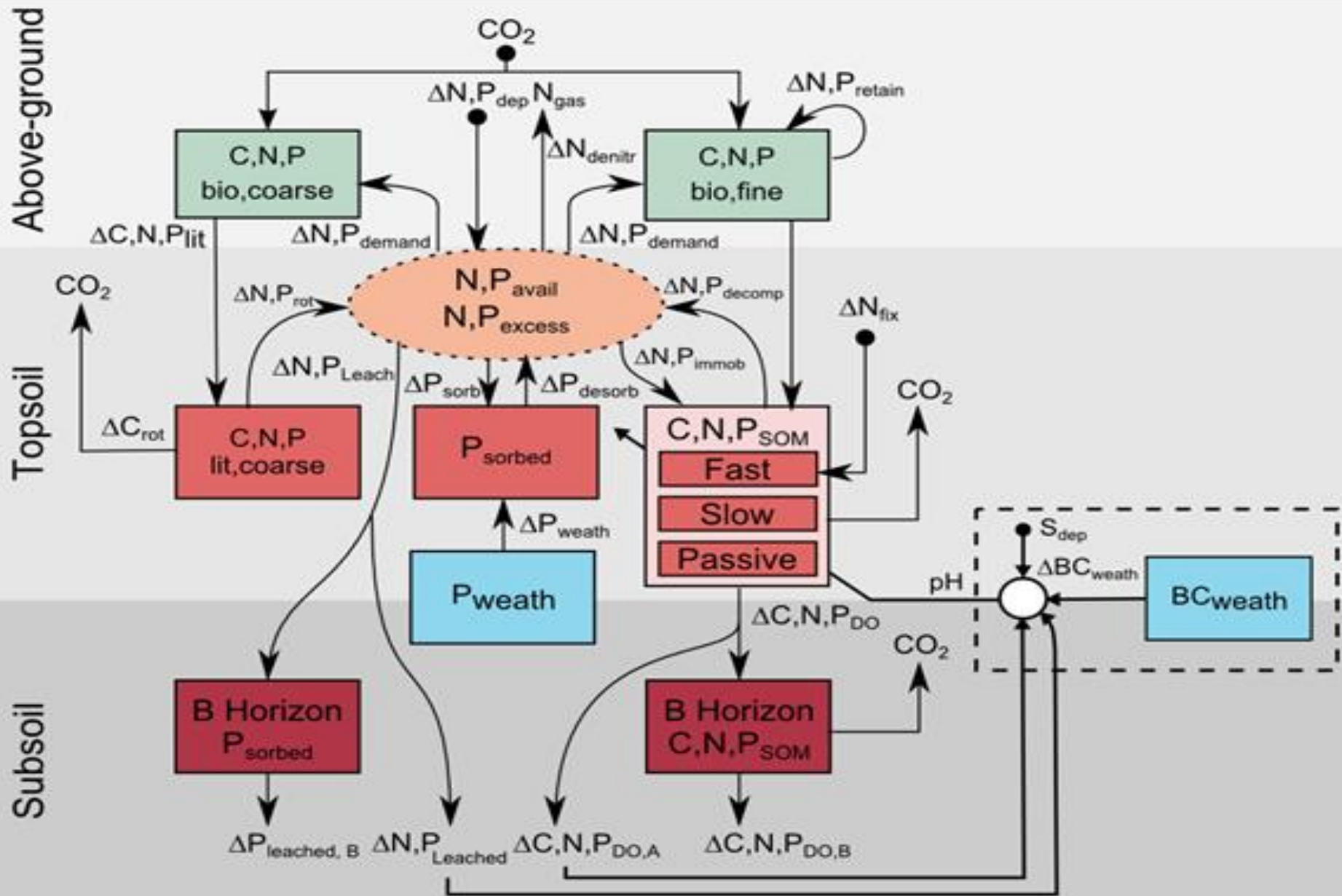
Seasonal / annual (1800-2000)
soil C, N, P pools
net primary productivity (NPP)
inorganic N and P leaching fluxes
DOC, DON, DOP leaching fluxes
(erosion)

by 5 x 5 km grid cell, by land use type

HAVE

Land cover maps 2007, ~1930, ~1700
Recent climate, past anomalies
Soil and geological maps
Atmospheric deposition 1800-present
Palaeo-ecology

N14CP



Features of the model

*Links the C,
N and P
cycles*

*Pools and
fluxes*

*Quarterly
timestep*

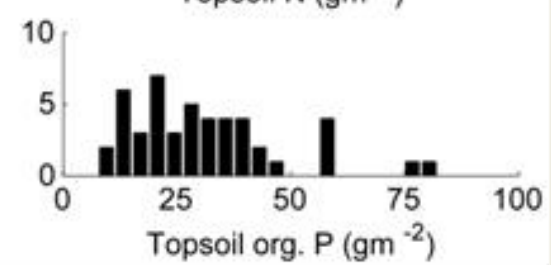
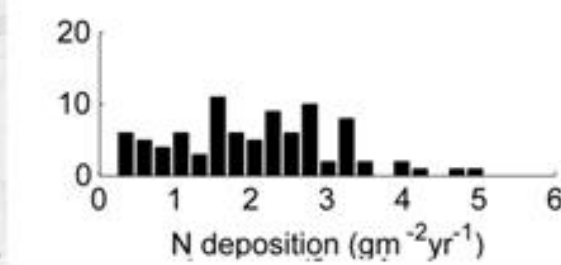
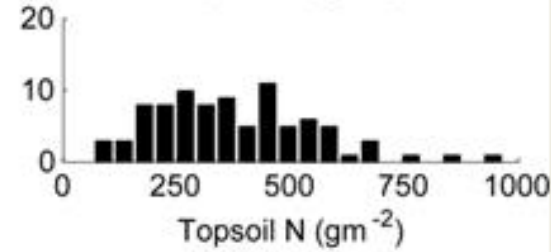
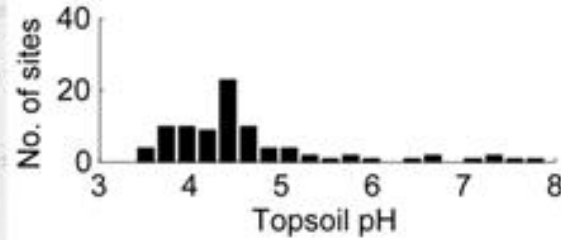
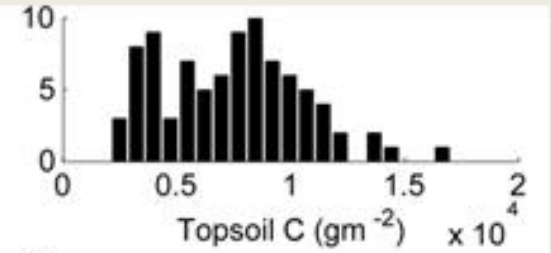
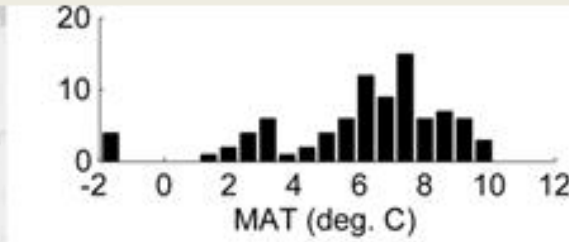
*Microbes not
explicitly modelled*

*Simultaneous
simulation of many
variables*

*Runs over the
Holocene (12000 yr)*

*Fitted from field data
(at plot scale)*

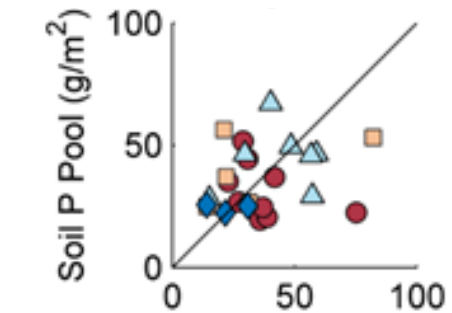
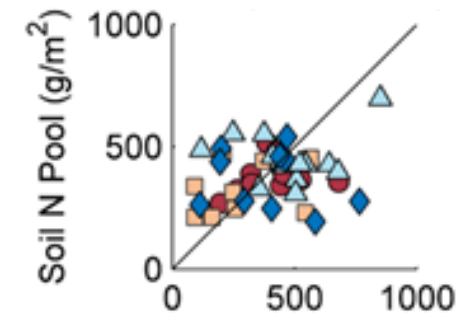
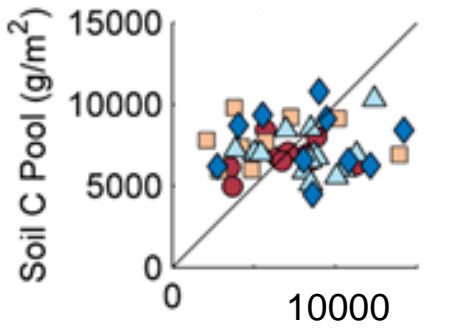
Fitting N14CP: plot data



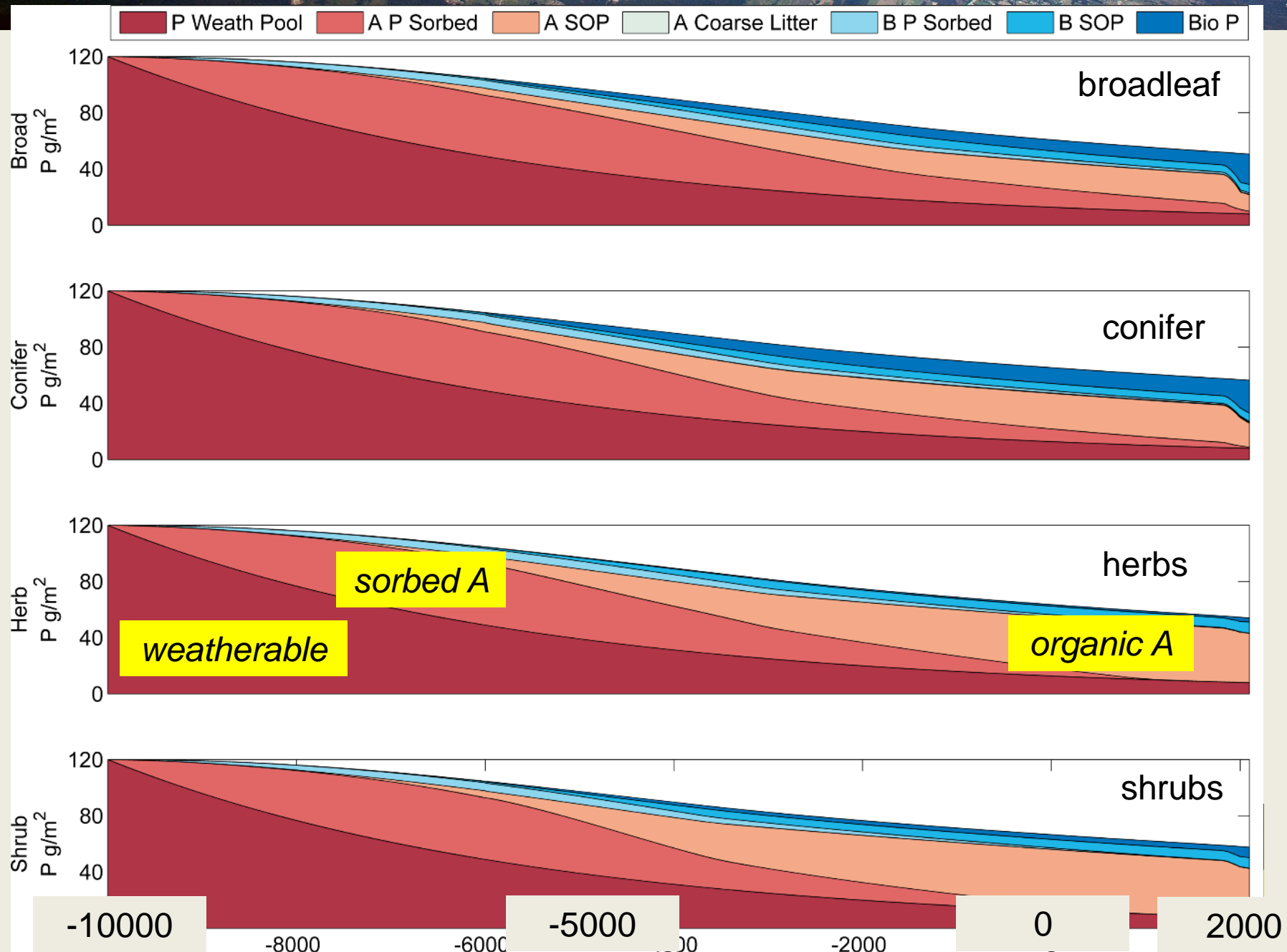
14C data for other sites!

N14CP fitting results: soil C N and P pools

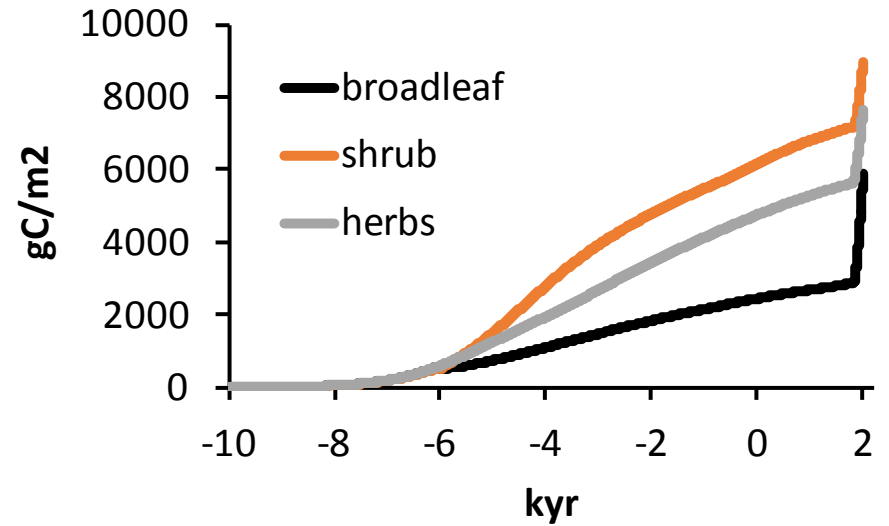
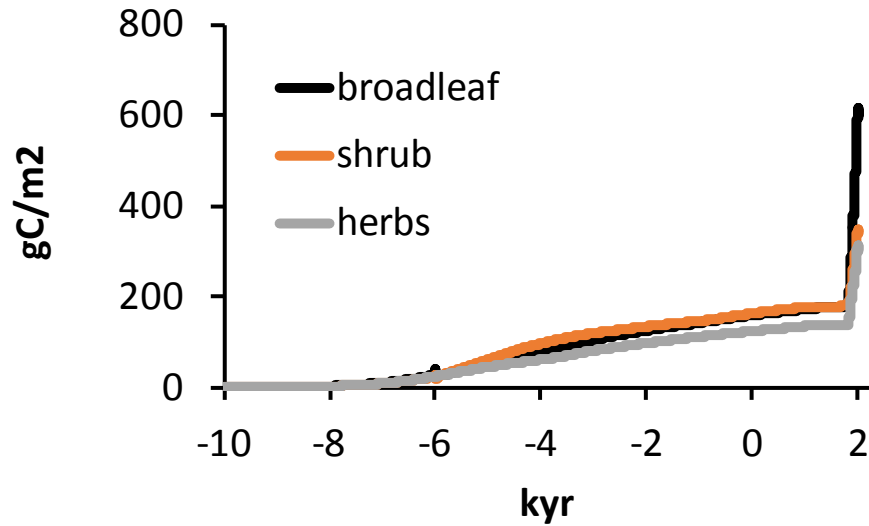
Generalised Model
Param. Sites



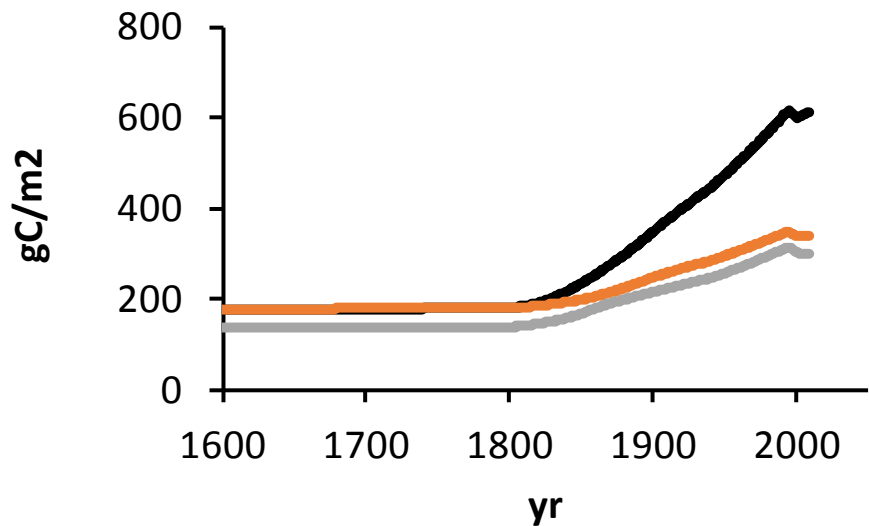
Soil P pools over the Holocene



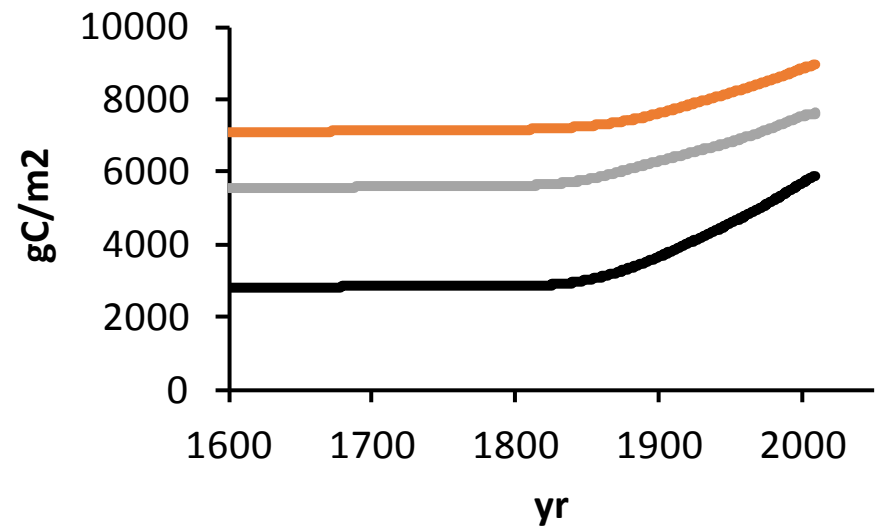
Semi-natural ecosystems / median climate and N deposition



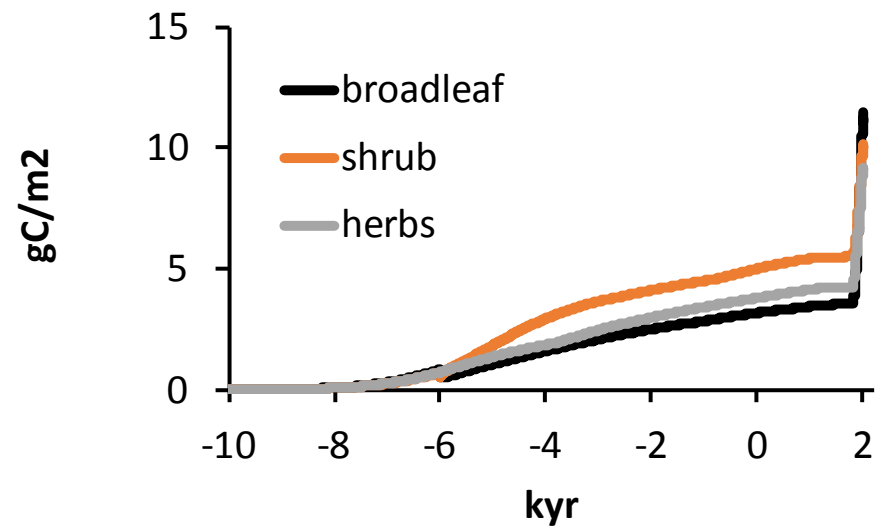
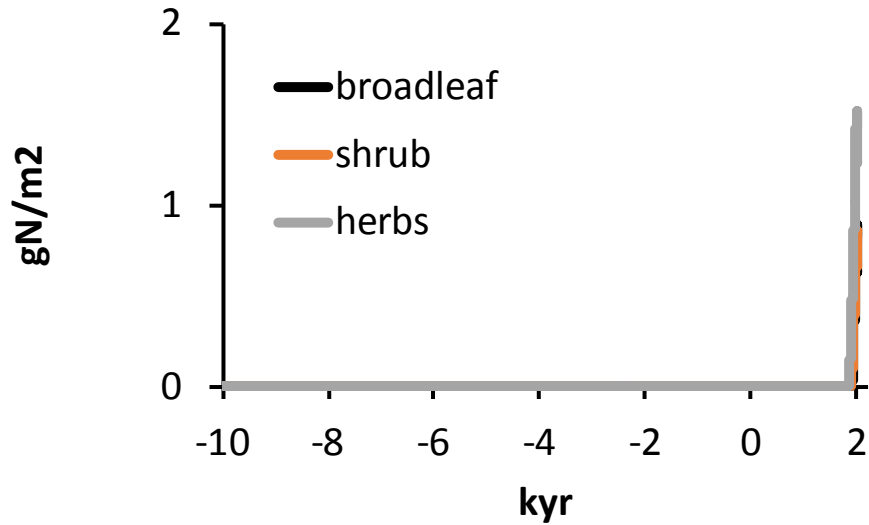
Net Primary Productivity



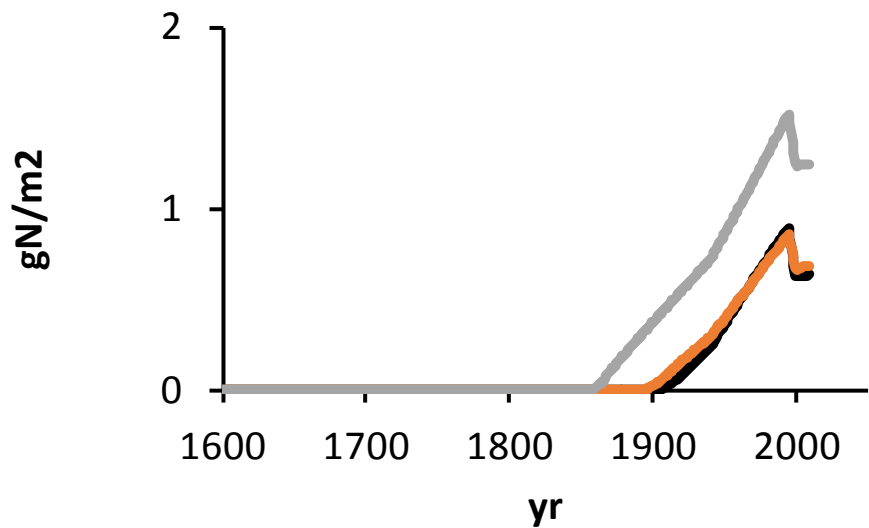
Soil organic C



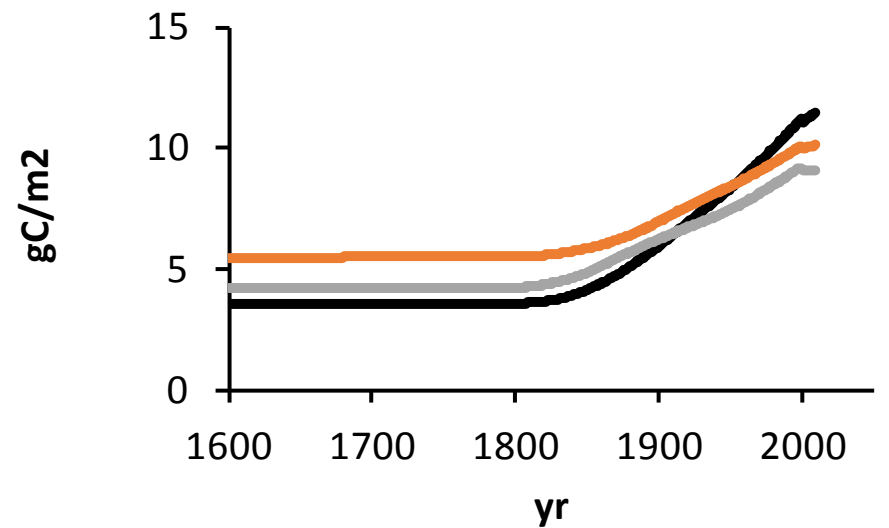
Semi-natural ecosystems / median climate and N deposition



Inorganic N leaching

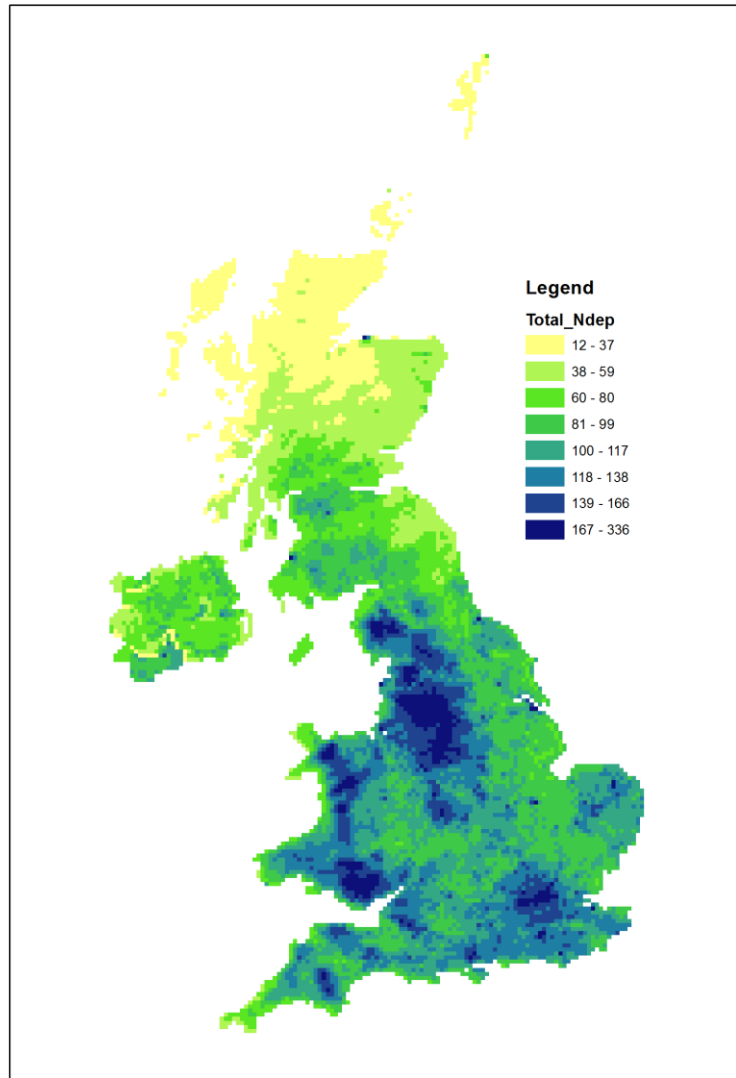


DOC leaching

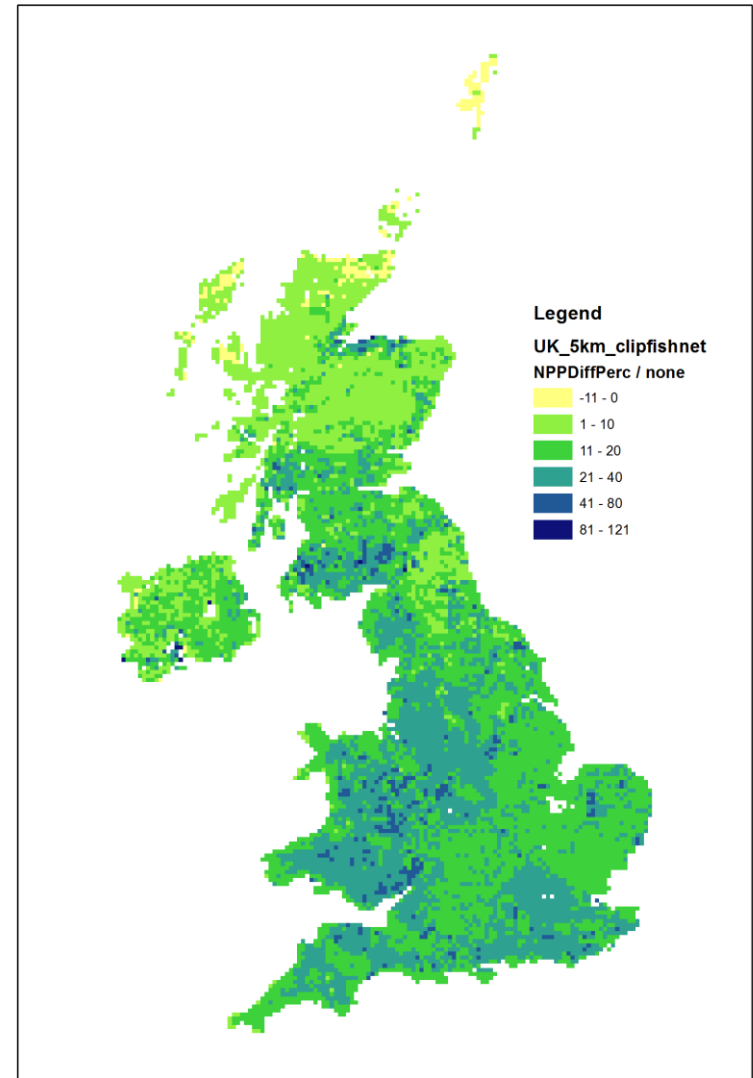


Net Primary Productivity & N deposition

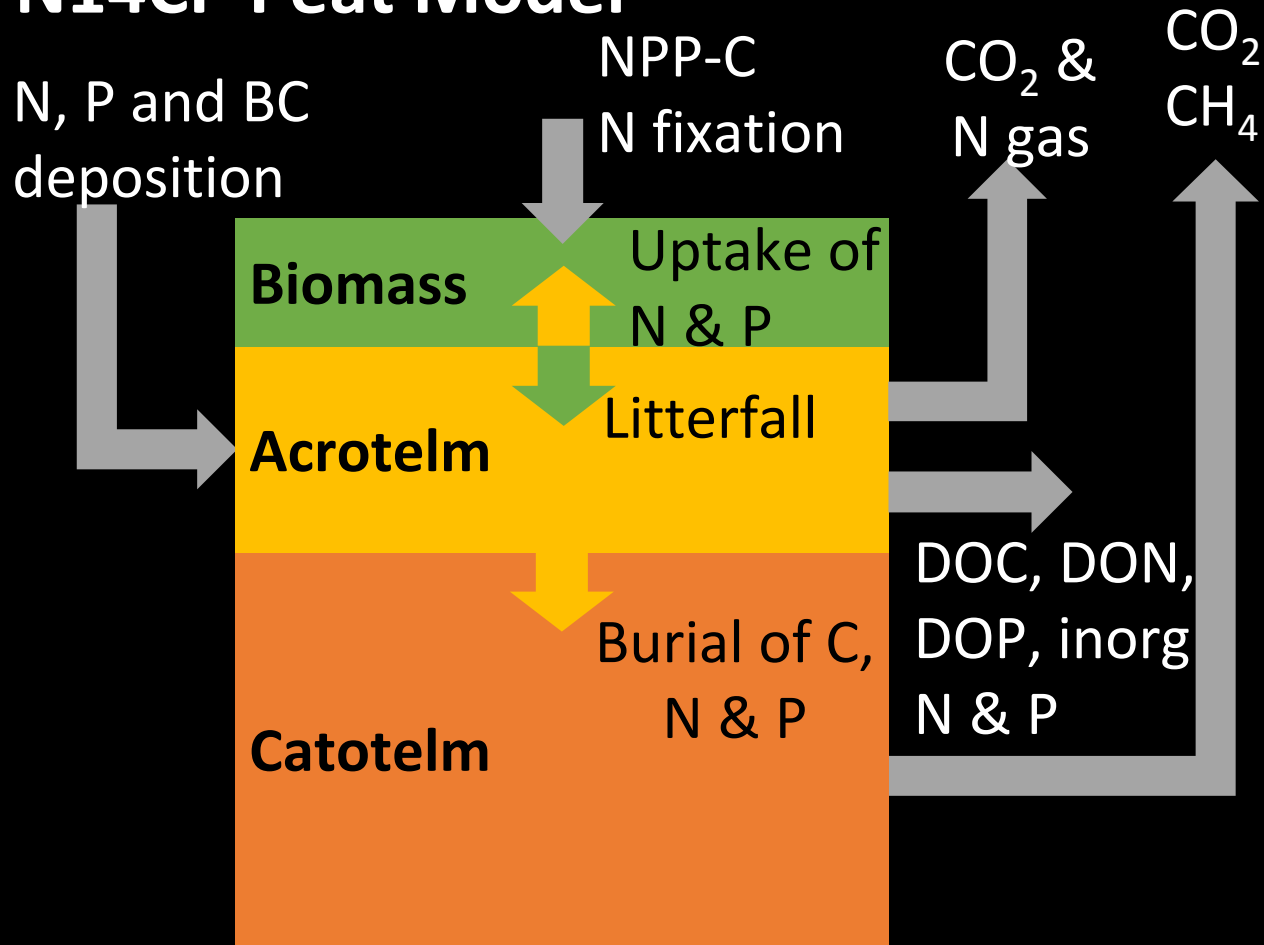
**Cumulative Ndep (g/m²)
1900-2000**



**Simulated % increase in NPP
1900-2000**

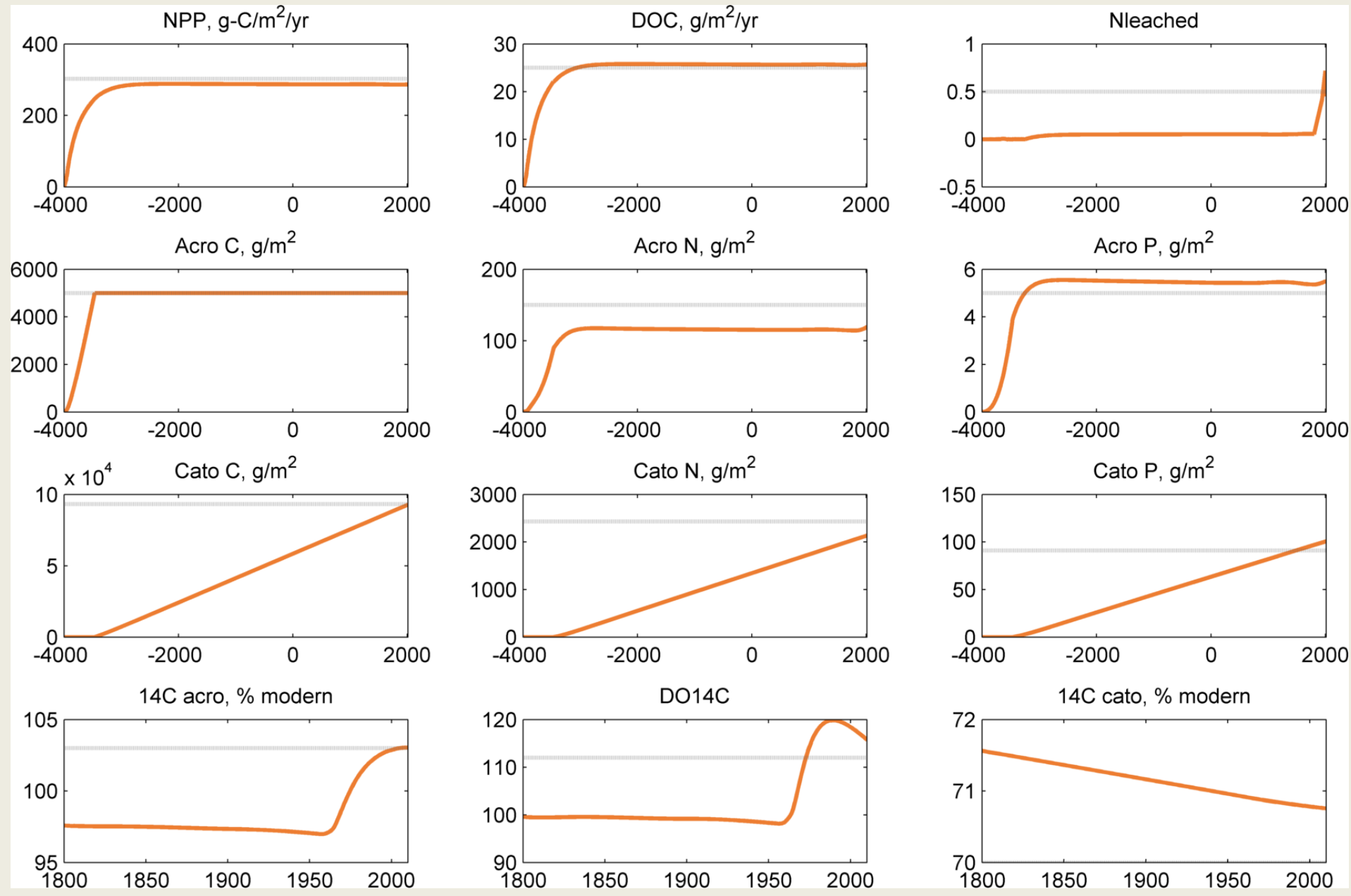


N14CP Peat Model



- Burial of C N and P occurs once the acrotelm reaches a certain size.
- These nutrients then become disconnected hydrologically, and undergo very slow decomposition.

BLANKET PEAT (acrotelm, catotelm)



Current situation

Completed or nearly-completed

Parameterisation complete

Paper in review – importance of P, increases in NPP etc

Application to Rothamsted unfertilised long-term sites

Outputs to the LTLS integrated model

Testing NPP predictions

To be done

Testing – soil pools & fluxes

Scenario outputs

Collaboration on biodiversity

Computation of nutrient budgets over time