Long-Term Large-Scale Macronutrient Cycling: Semi-Natural Terrestrial Modelling

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Aims of Semi-Natural Terrestrial Modelling

1. Simulate plant-soil response to past 200 years of N deposition fertilization and future scenarios for whole UK
2. Simulate NPP for use in relation to biodiversity
3. Simulate dissolved fluxes to water bodies
4. Attribute nutrient content of sediments removed from SN land to rivers and lakes
5. Provide an initial nutrient state for agricultural simulations

To do this, we need a **simple** model, capable of simulating **many** grid cells over **long** timescales.

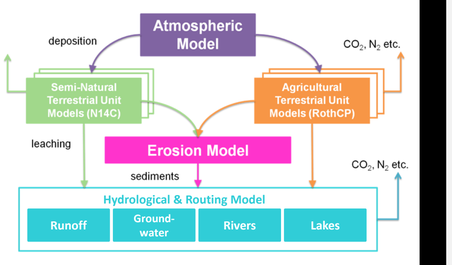


Fig. 1: LTLS Integrated Model

The Model: N14C

Simulates C, N and P simultaneously, using plant stoichiometry as primary constraint. Radiocarbon used to constrain soil organic matter turnover.

Inputs

Atmospheric: N, S and P deposition
14C in atmosphere
Soil Type: base cation and P weathering
Climate: mean seasonal temp. and mean annual rainfall
Land use history: plant cover

N14C Model

Simulates annually: Net Primary Productivity, Biomass CNP, Topsoil and Subsoil SOC SON SOP, Soil 14C, Sorbed P, Soil pH, N fixation

Outputs

DIC, DO14C, DOC, DON, TDP, NO3-N, Ca, SO4S Labile/Non-Labile POC, PON, POP, PO14C PADS, PIP

Parameterising the Model

The N14C model has been extended to include P cycling, pH and weathering.
Soil nutrient data from 88 sites in northern Europe are used to find a 'generalised' set of parameters for use in the new model i.e. one parameter set suitable for widespread use

Which parameters have most influence on the outputs?

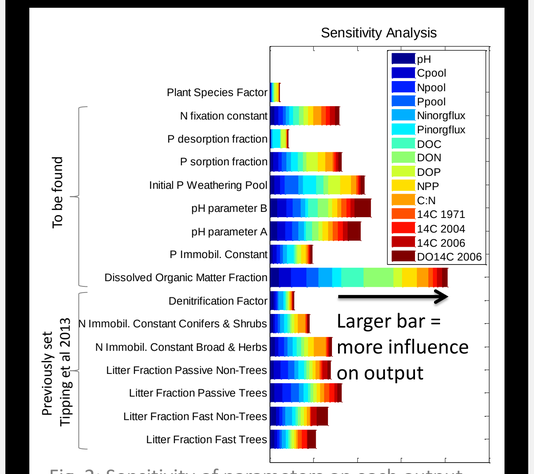
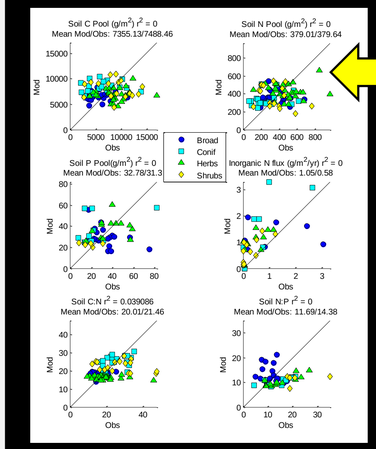


Fig. 2: Sensitivity of parameters on each output that can be compared with field data

We ran search algorithms to find values for 8 parameters that provide the best match to site data.

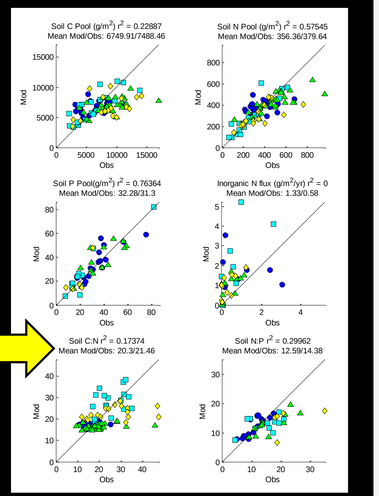
Model Vs Data

General parameter set



The generalised parameter set matches mean observations well. However, it does not reproduce inter-site variation.

Site-based initial bedrock P



By allowing the assumed initial pool of weatherable bedrock P to vary at each site, the results can be improved signficantly.
P inputs from weathering is potentially an important control on soil C and N.

Have a question?
Ask me, mail me or tweet me.
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