

Soil modelling study VSD+

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Acknowledgements

Collaboration on model application: Thomas Dirnböck, Max Posch, Julian Aherne, Kari Austnes, Jelena Beloica, Alessandra de Marco, Francesca Fornasier, Martyn Futter, Tomasz Pecka, Ed Rowe, Thomas Scheuschner, Salar Valinia.

Model development: Luc Bonten, Janet Mol, Max Posch, Gert Jan Reinds, Wieger Wamelink

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Outline

Background, rationale

Modelling setup

Site locations 40 sites

Calibrations 14 sites

Simulations 10 sites

Next tasks

On-going pressures

Climate change

- Warming: earlier start of growth, later end of growth
- Seasonal or annual drought
- Heavy rainfall events, drought spells

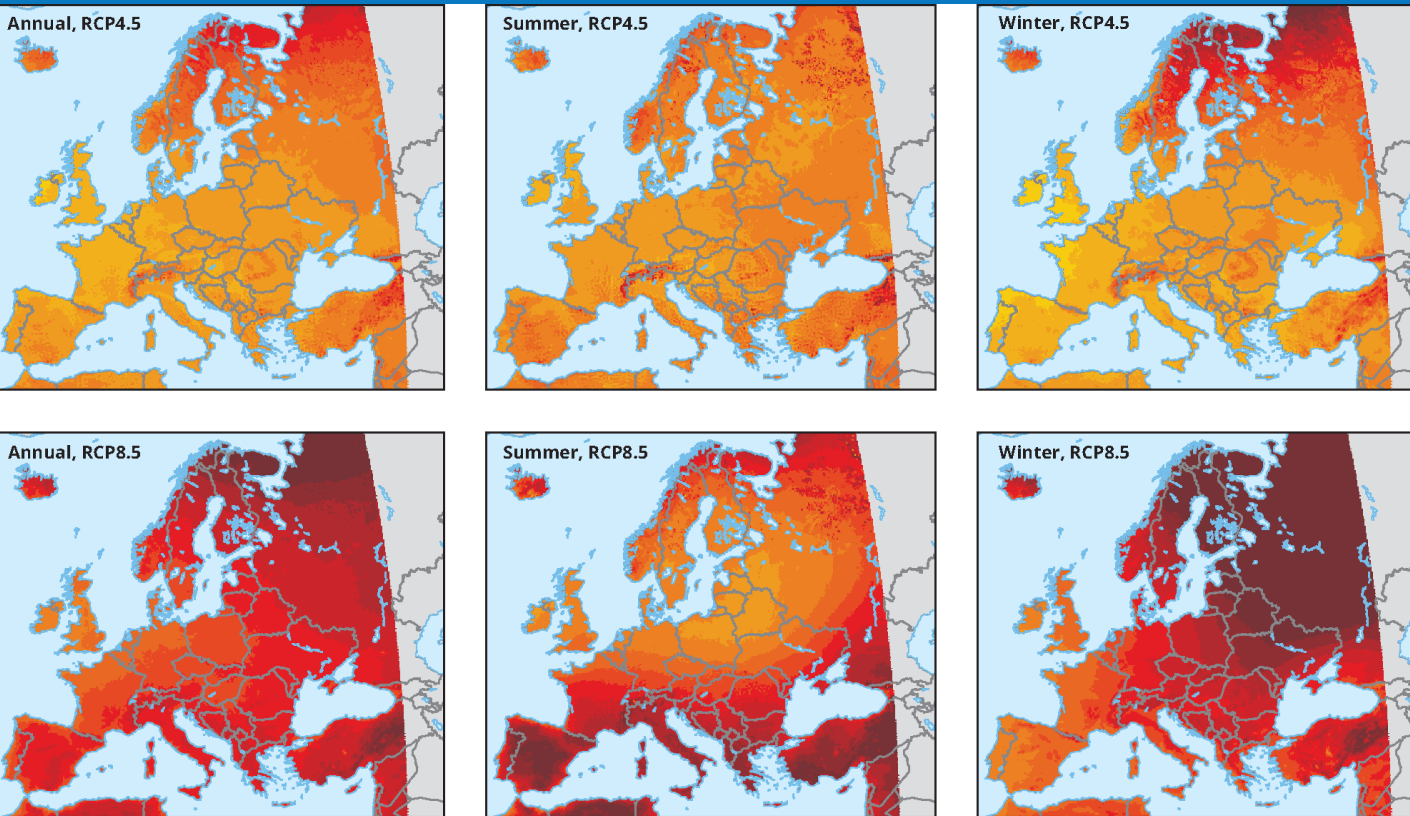
Air pollution

- Sulphur shows decreasing trends
- Nitrogen stable or some increase

Management

- Increased use of bioenergy, e.g. to mitigate climate change
- Decreased motivation for protection of biodiversity

Spatial variation in future climate: Temp.



Projected change in annual, summer and winter temperature for the forcing scenarios RCP4.5 and RCP8.5

°C

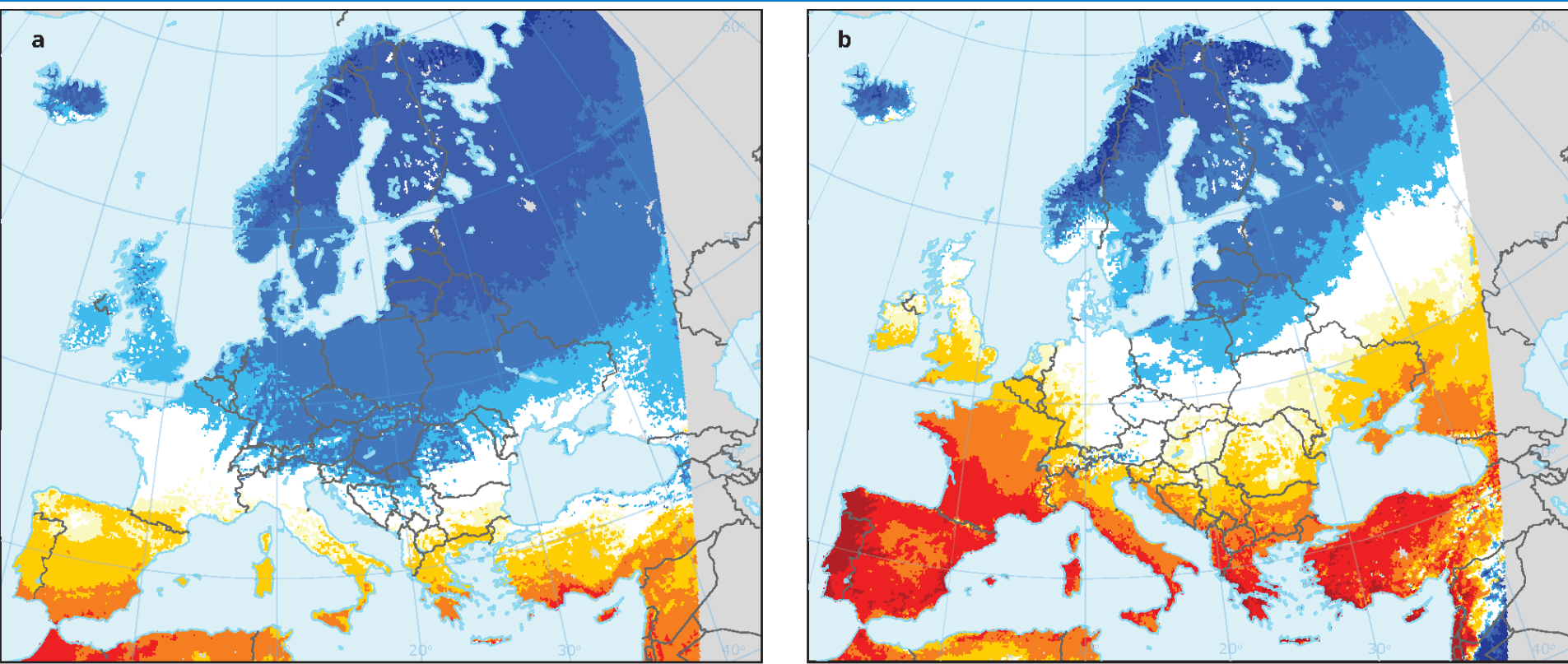
1.5 to 2
2 to 2.5
2.5 to 3
3 to 3.5
3.5 to 4
4 to 4.5
4.5 to 5
5 to 5.5
5.5 to 6
>6

Outside coverage

0 500 1000 1500 km

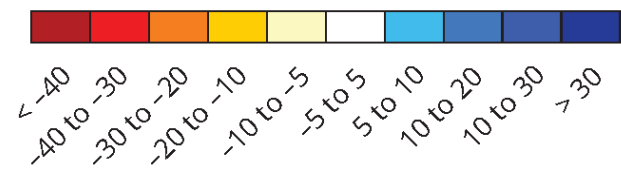
Projected changes in annual (left), summer (middle) and winter (right) near-surface air temperature (°C) in the period 2071-2100, compared to the baseline period 1971-2000 for the forcing scenarios RCP 4.5 (top) and RCP 8.5 (bottom). Model simulations are based on the multi-model ensemble average of RCM simulations from the EURO-CORDEX initiative. <http://www.euro-cordex.net/>

Spatial variation in future climate: Prec.



Projected change in annual (a) and summer (b) precipitation

%

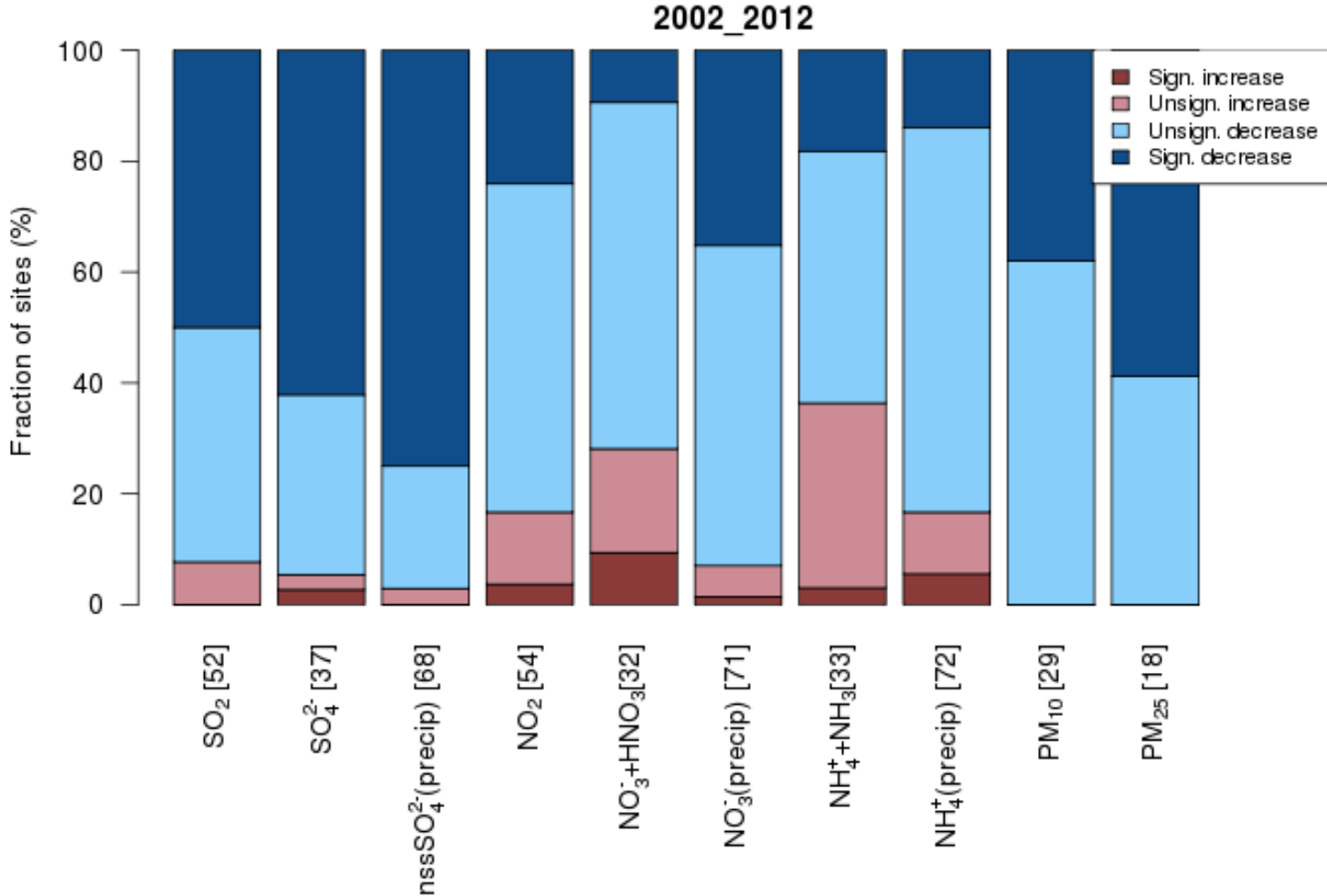


Outside coverage

0 500 1000 1500 km

Projected changes in annual (left) and summer (right) precipitation (%) in the period 2071-2100 compared to the baseline period 1971-2000 for the forcing scenario RCP 8.5. Model simulations are based on the multi-model ensemble average of RCM simulations from the EURO-CORDEX initiative. <http://www.euro-cordex.net/>

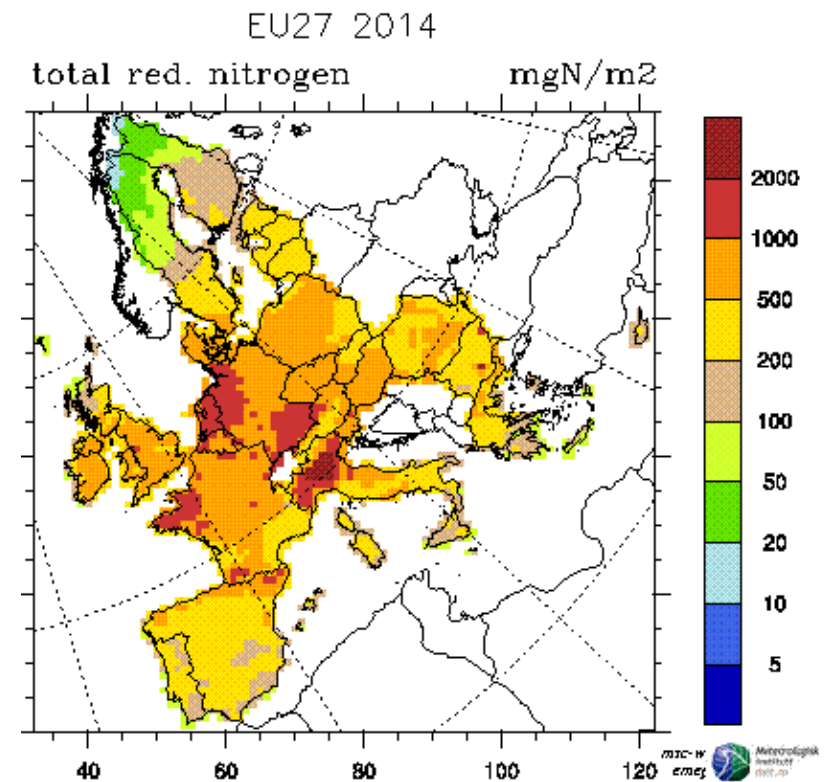
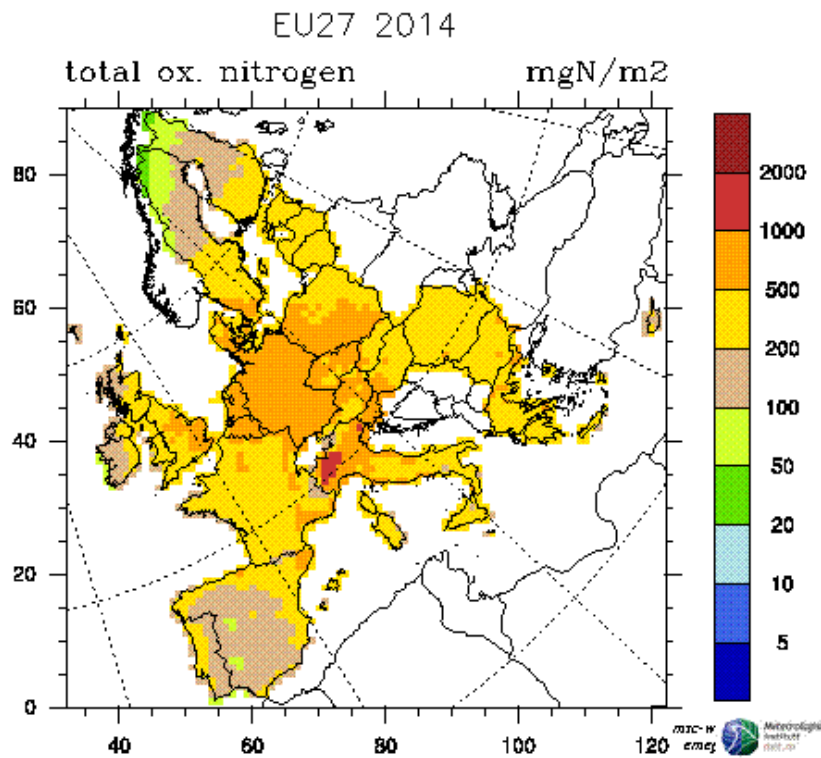
Deposition trends: S decreased, N remains concern



EMEP Task Force on Measurement and Modelling Trend Report, Final Draft:
http://www.nilu.no/projects/ccc/tfmm/utrecht_2016/TFMM_TrendAR_20160513.pdf



Spatial variation in N deposition



EMEP SR 2015 <http://www.emep.int/mscw/>

Soil and habitat responses

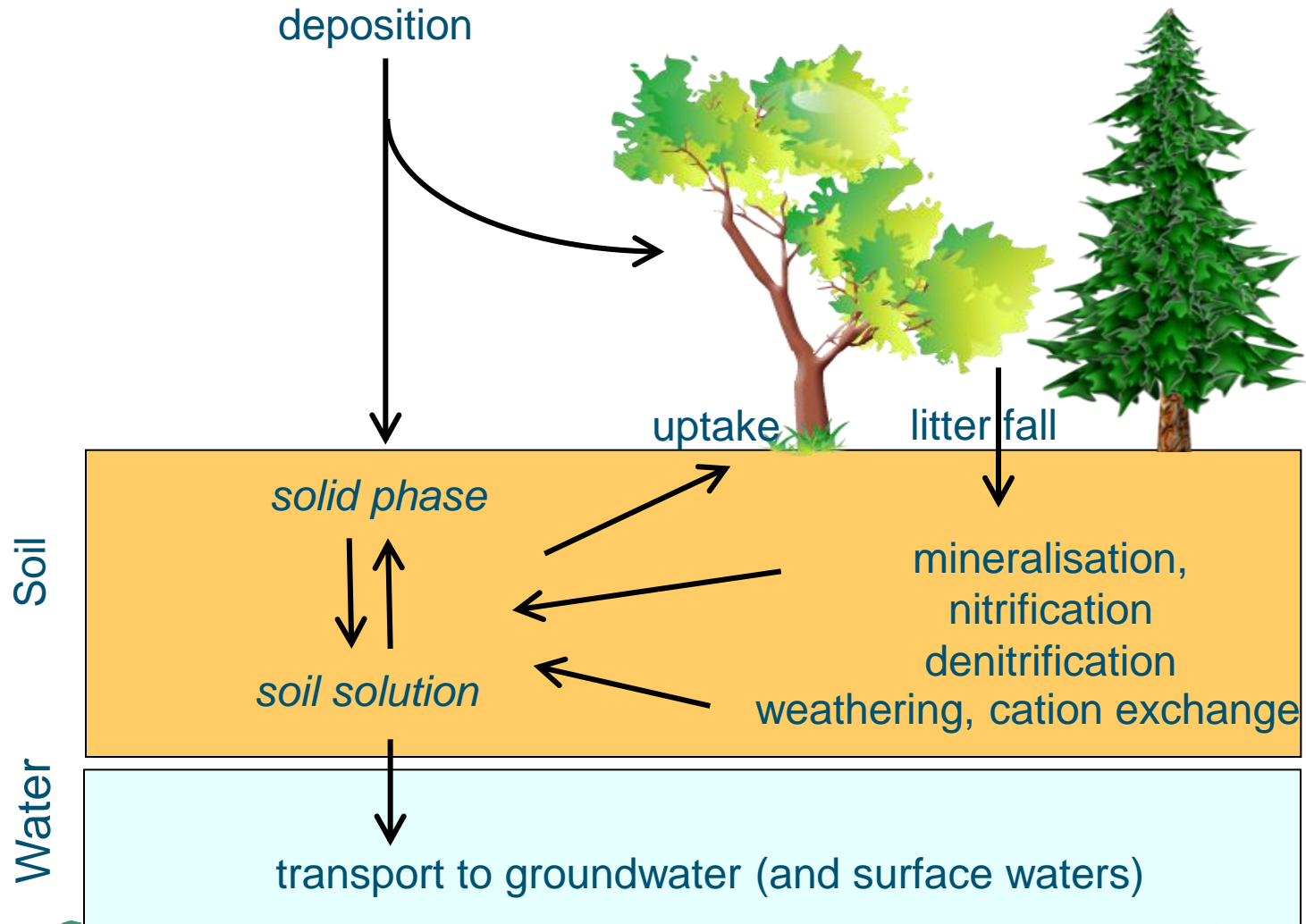
Air pollution, climate change, management

- Affect vegetation on the species and habitat levels
- Varies with region, latitude, policy
- Understanding soil dynamics will help evaluate vegetation response

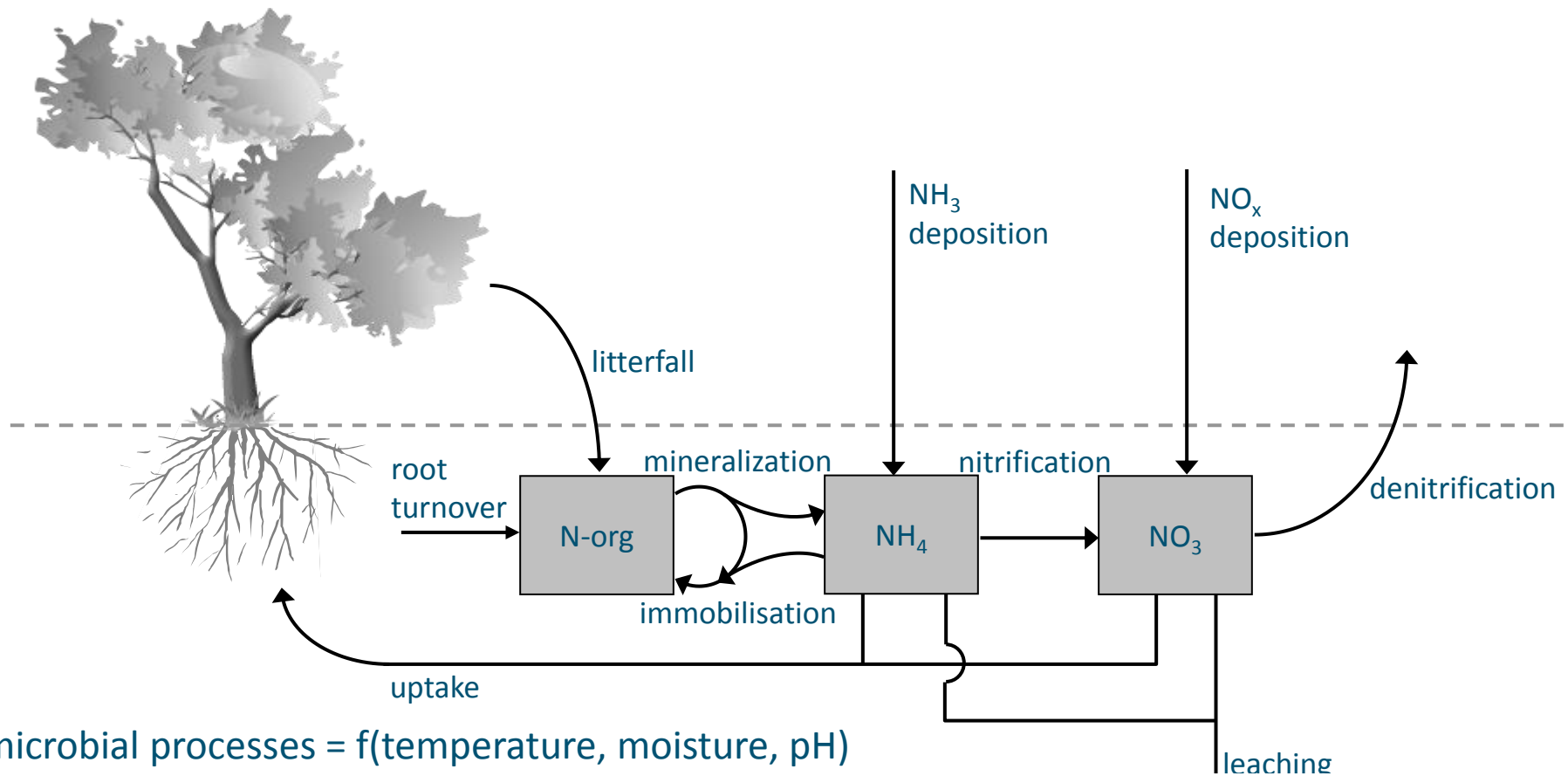
Overall aim to test VSD+ model chain to evaluate habitat responses

- Part I: Soil abiotic responses (Maria Holmberg et al.)
- Part II: Habitat responses (Thomas Dirnböck et al.)

VSD+



N processes in VSD+



microbial processes = $f(\text{temperature, moisture, pH})$

Bonten et al. 2016. *Env Soft* 79:75-84.

<http://dx.doi.org/10.1016/j.envsoft.2016.01.009>

RothC 26.3 model in VSD+

Carbon pools

1. Decomposable plant material
2. Resistant plant material
3. Microbial biomass
4. Humified organic matter
5. *Inert organic matter*

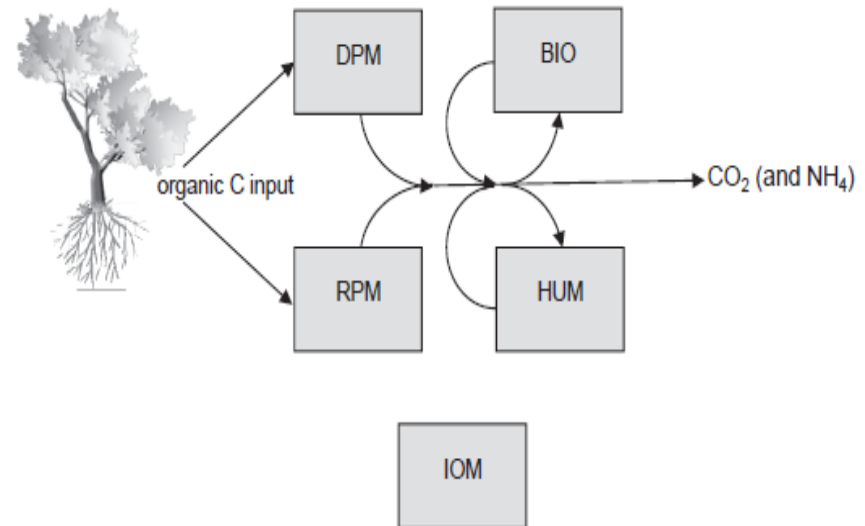
First-order processes for turnover of pools 1-4. Temperature, soil moisture and soil cover modify rates.

Bonten et al. 2016. *Env Soft* 79:75-84.

<http://dx.doi.org/10.1016/j.envsoft.2016.01.009>

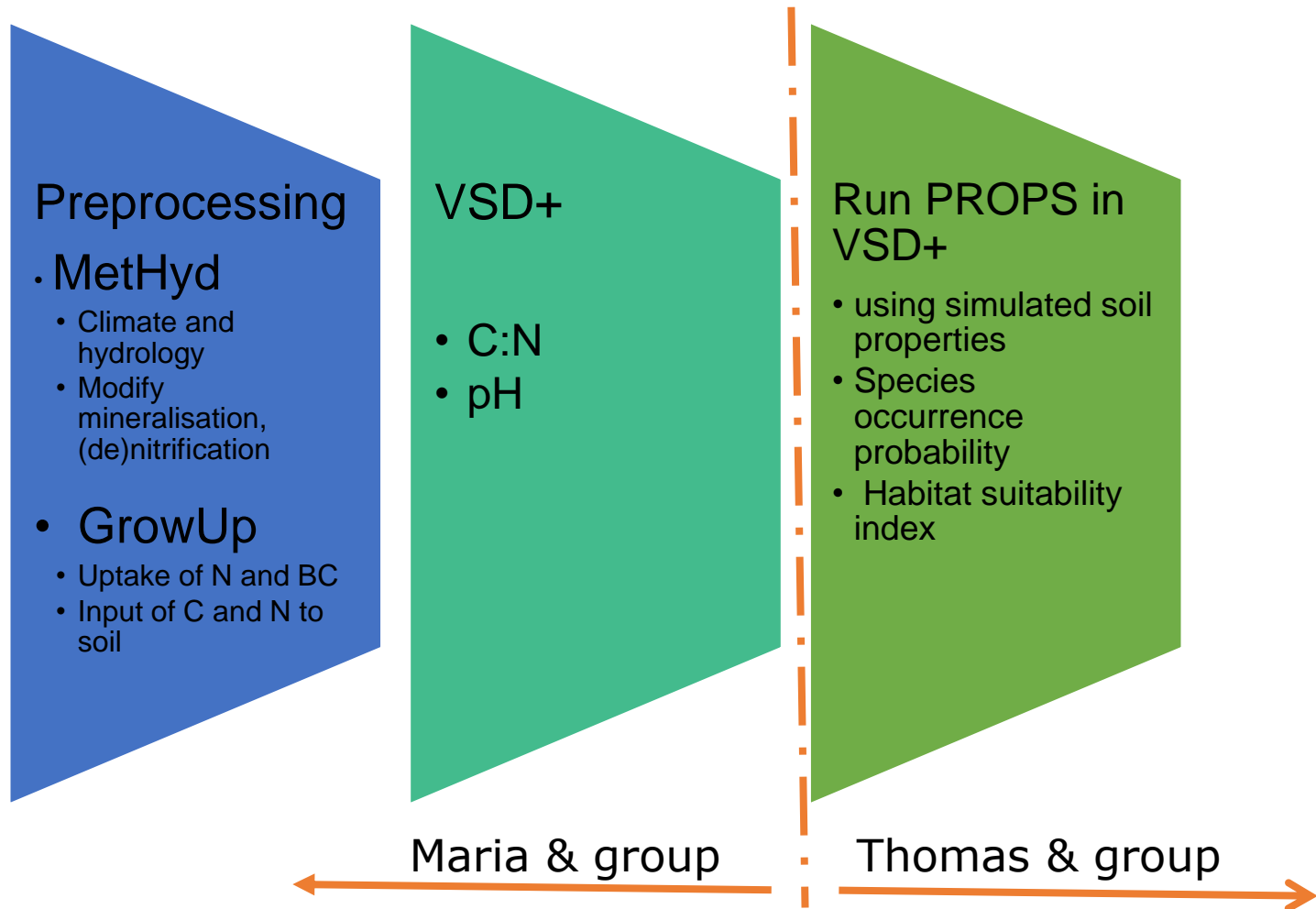
Coleman & Jenkinson 2104

http://rothamsted.ac.uk/sites/default/files/users/kcoleman/RothC_guide_DOS.pdf)

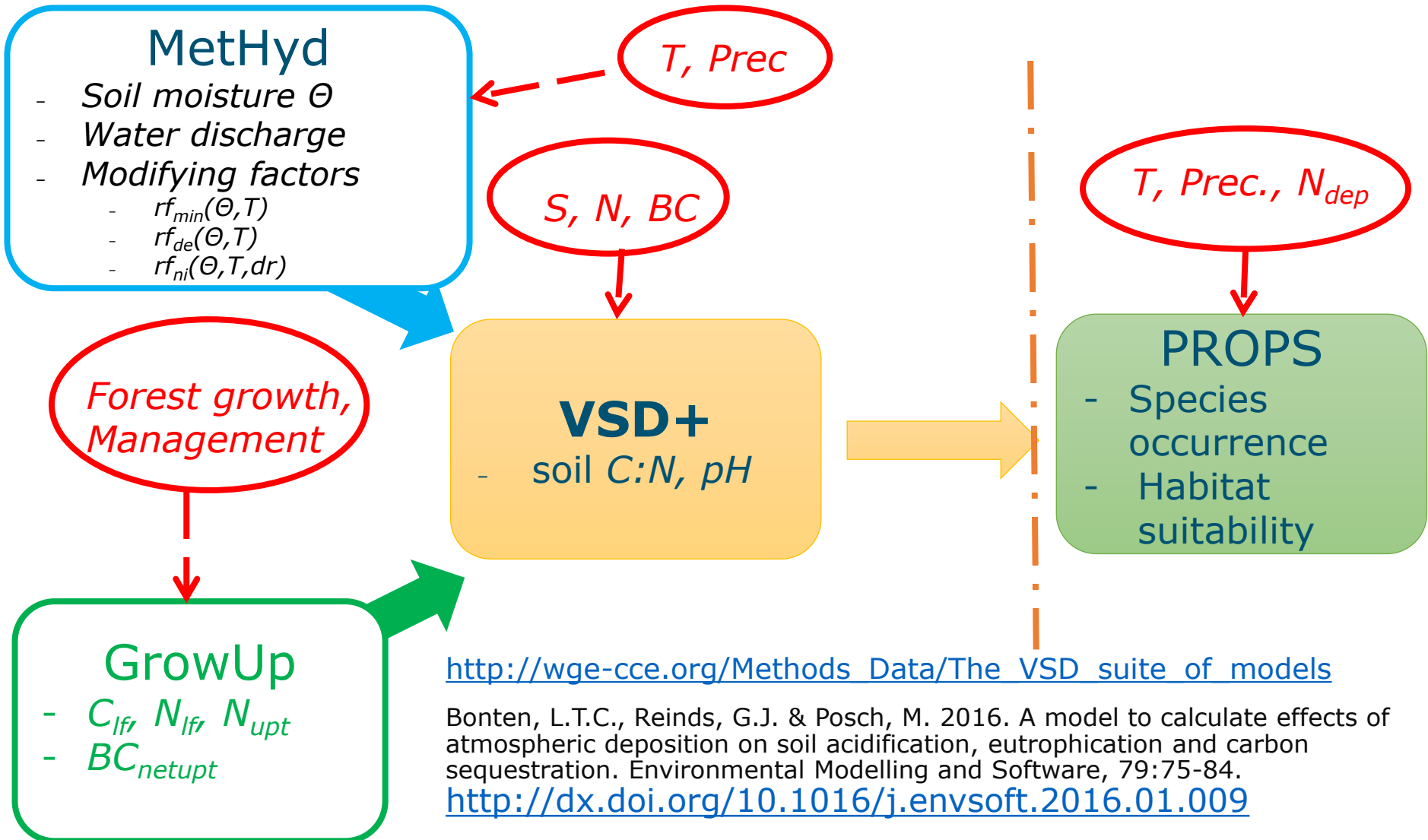


VSD+ model chain

http://wge-cce.org/Methods_Data/The_VSD_suite_of_models



VSD+ model chain



Objectives – soil modelling

Study impacts of N deposition and climate warming on soil conditions

Run VSD+ with deposition and climate scenarios

- Primary input
 - S, N dep
 - annual precip., annual temperature
 - Forest growth
- Primary output
 - Soil pH, (BS), C:N
- Key variables delivered to vegetation response analysis
 - N dep, temperature, precipitation
 - Soil pH, C:N

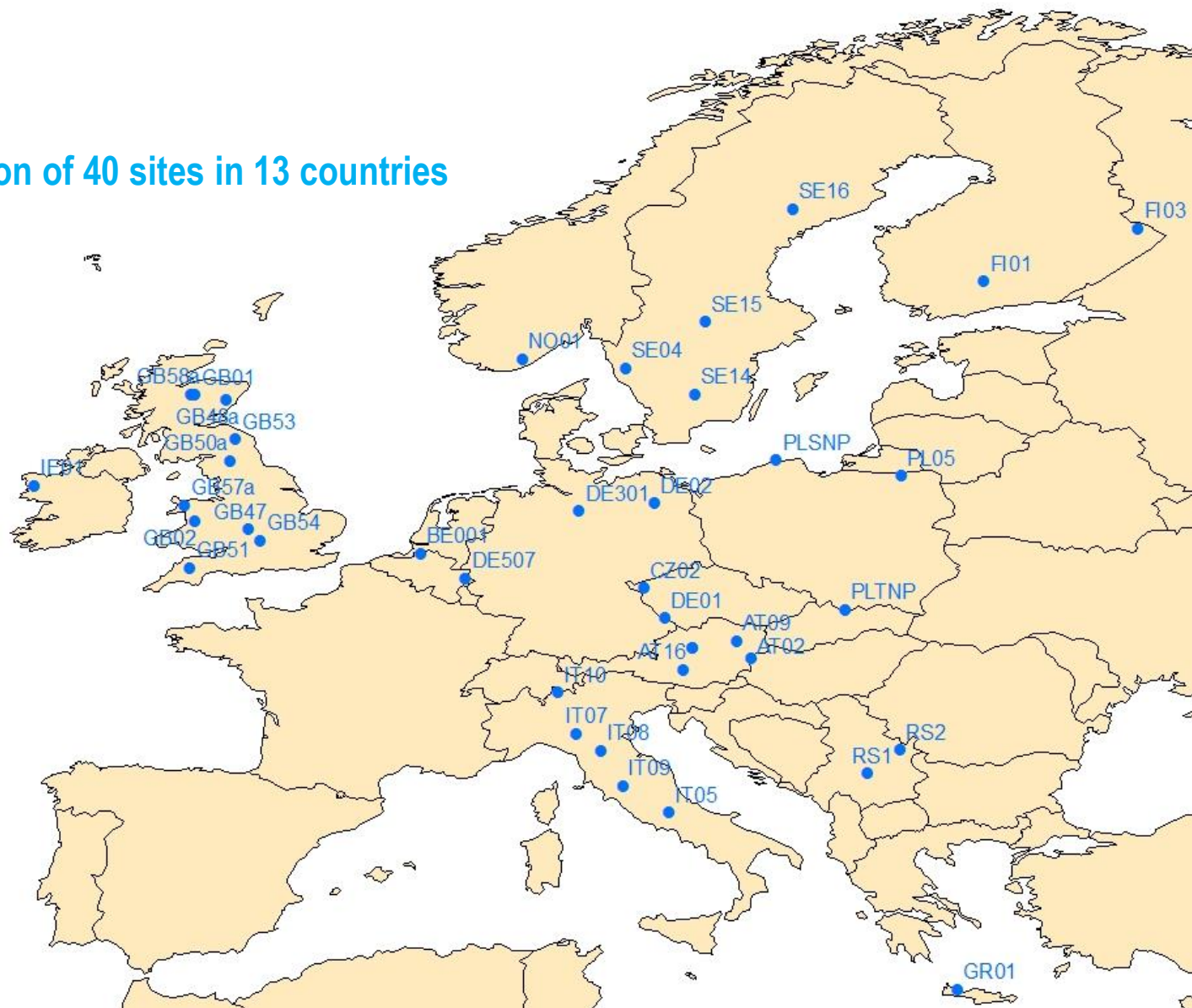
Illustrate regional variability in response

- Analyze cross-site differences

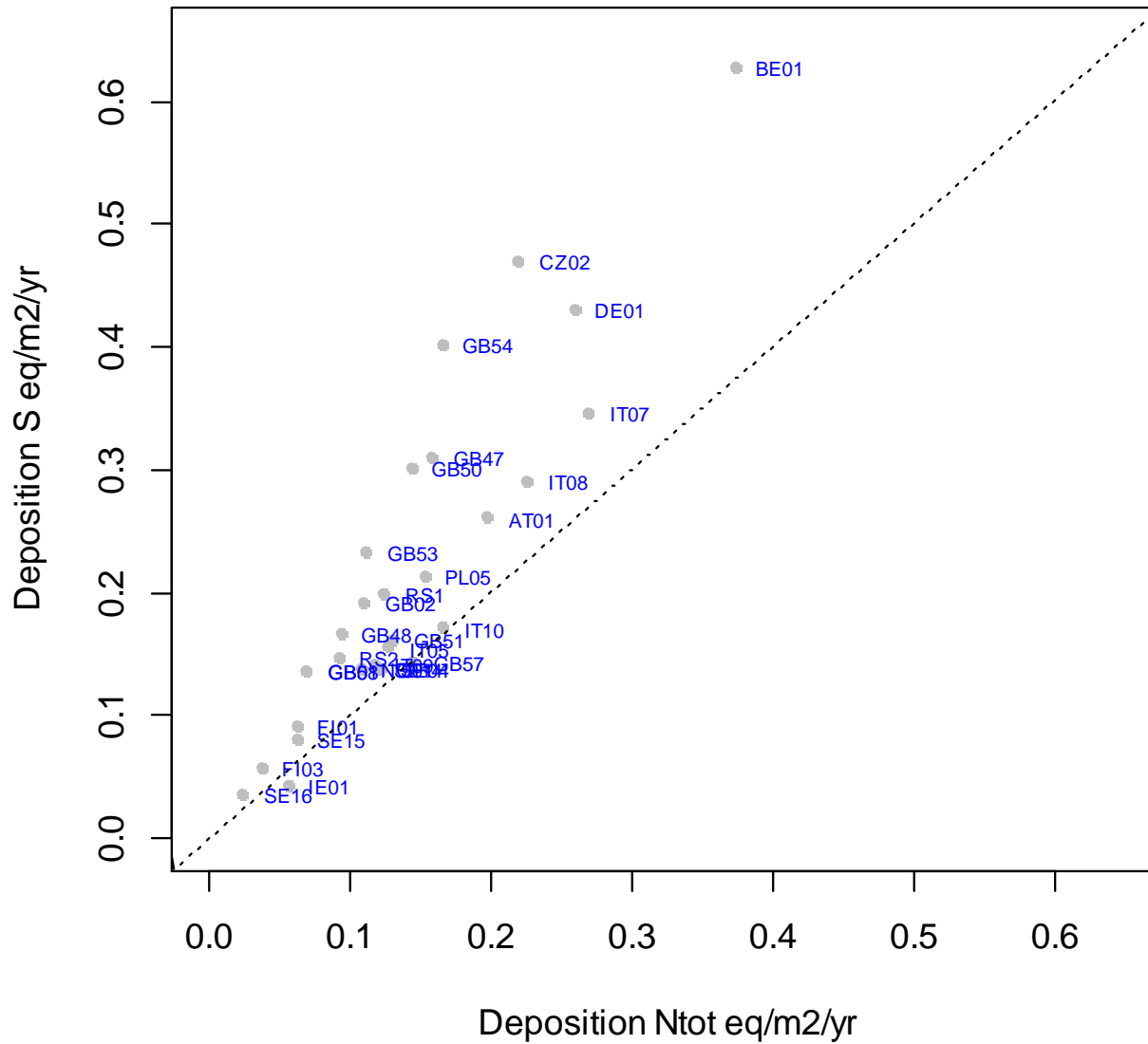
Work towards manuscript to special issue in STOTEN on theme "Detecting and explaining natural and anthropogenic changes by making use of large extent, long-term ecological research facilities of the international long-term ecosystem research (ILTER) network". (dl July 2017)

Potential participation of 40 sites in 13 countries

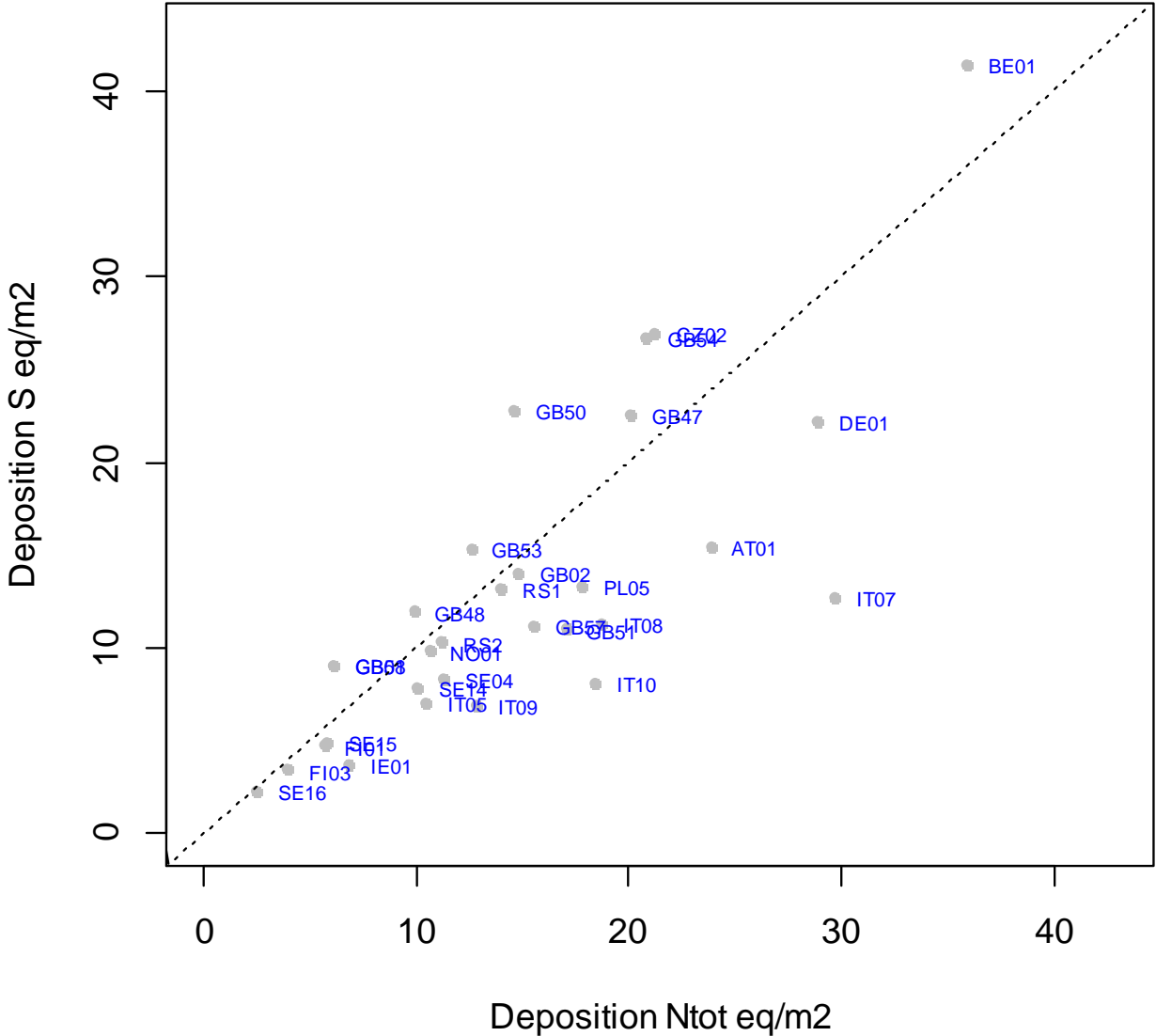
13 countries	40 sites
Austria	5
Belgium	1
Czech Republic	1
Germany	4
Greece	1
Finland	2
UK	10
Ireland	1
Italy	5
Norway	1
Poland	3
Serbia	2
Sweden	4



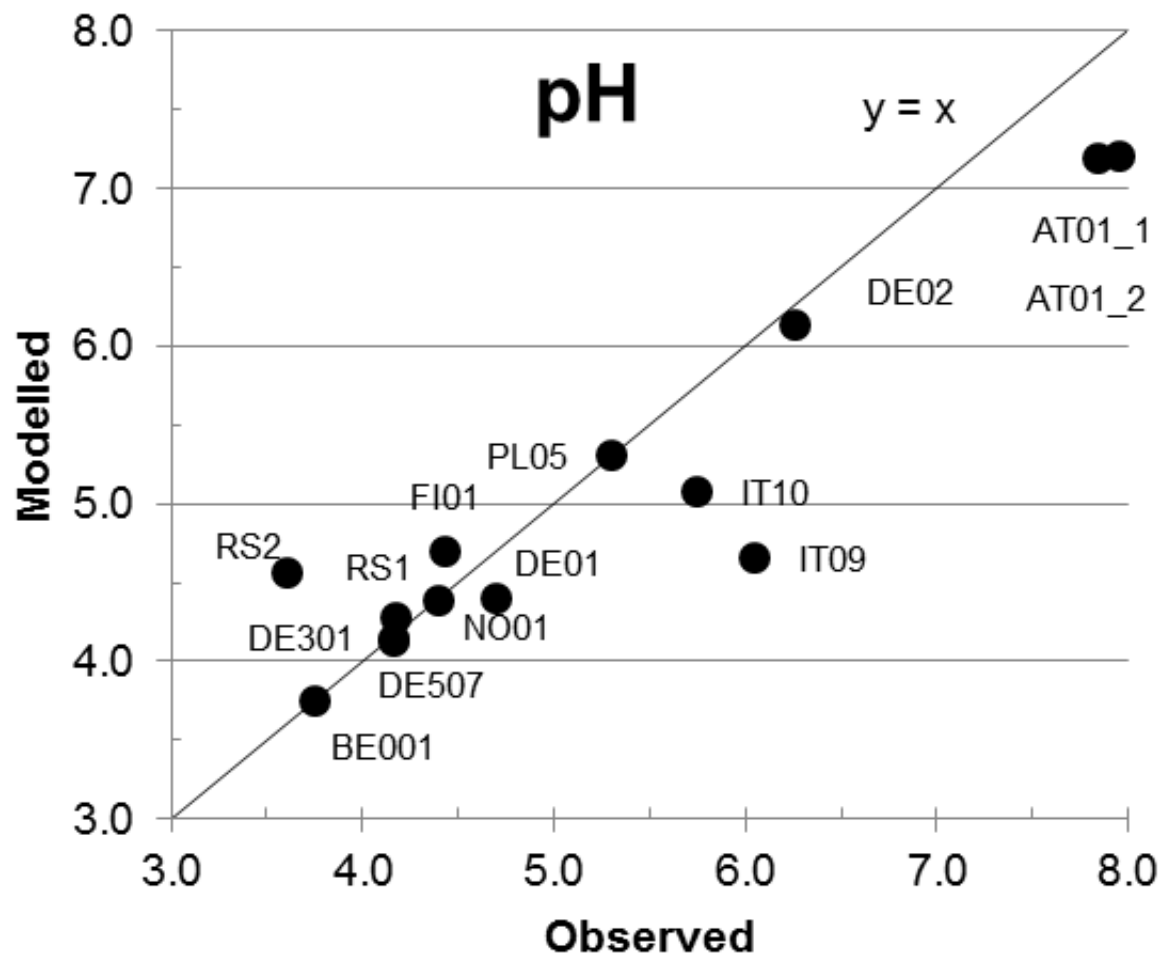
Peak deposition to forest



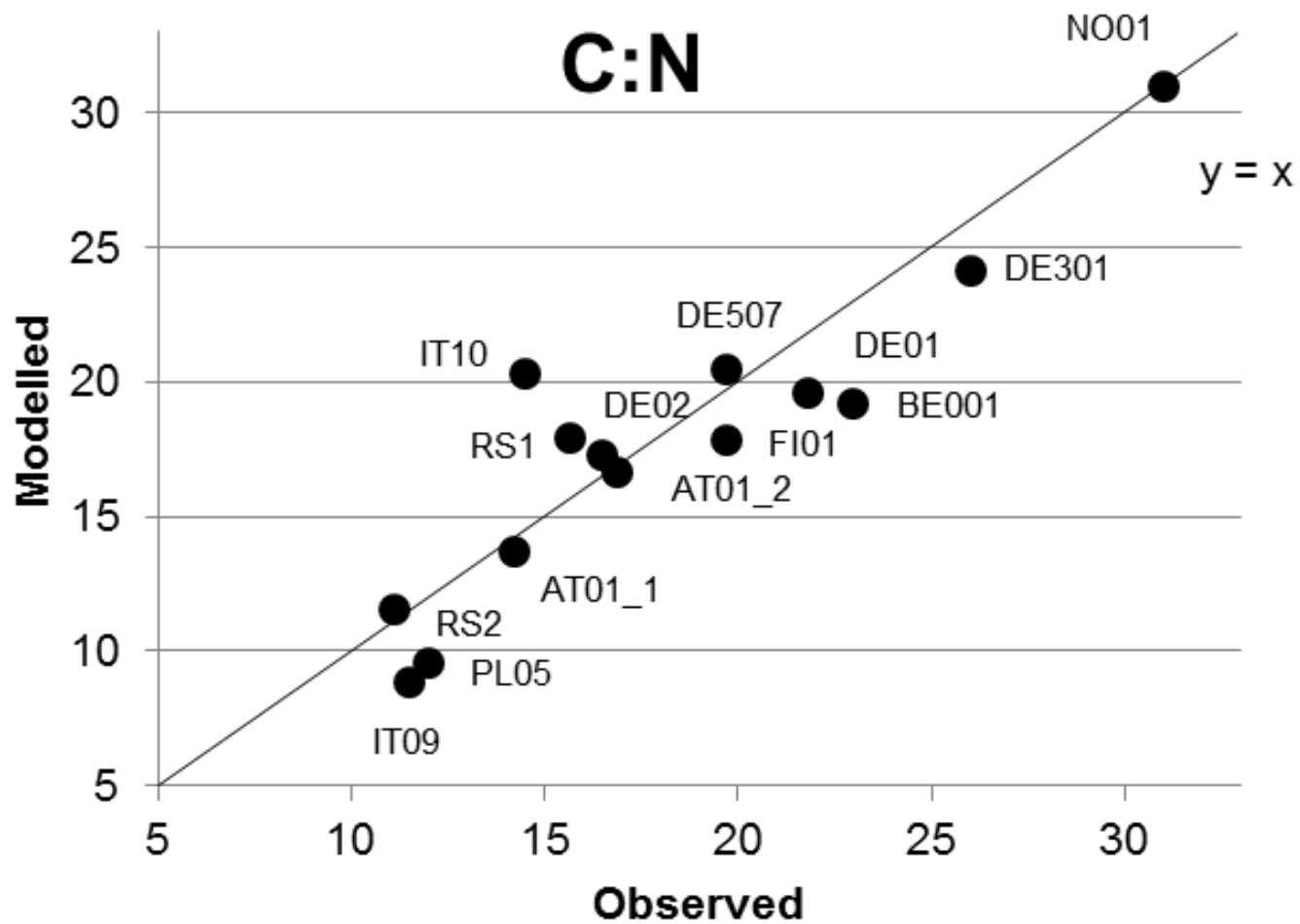
Cumulative forest deposition 1880 - 2100



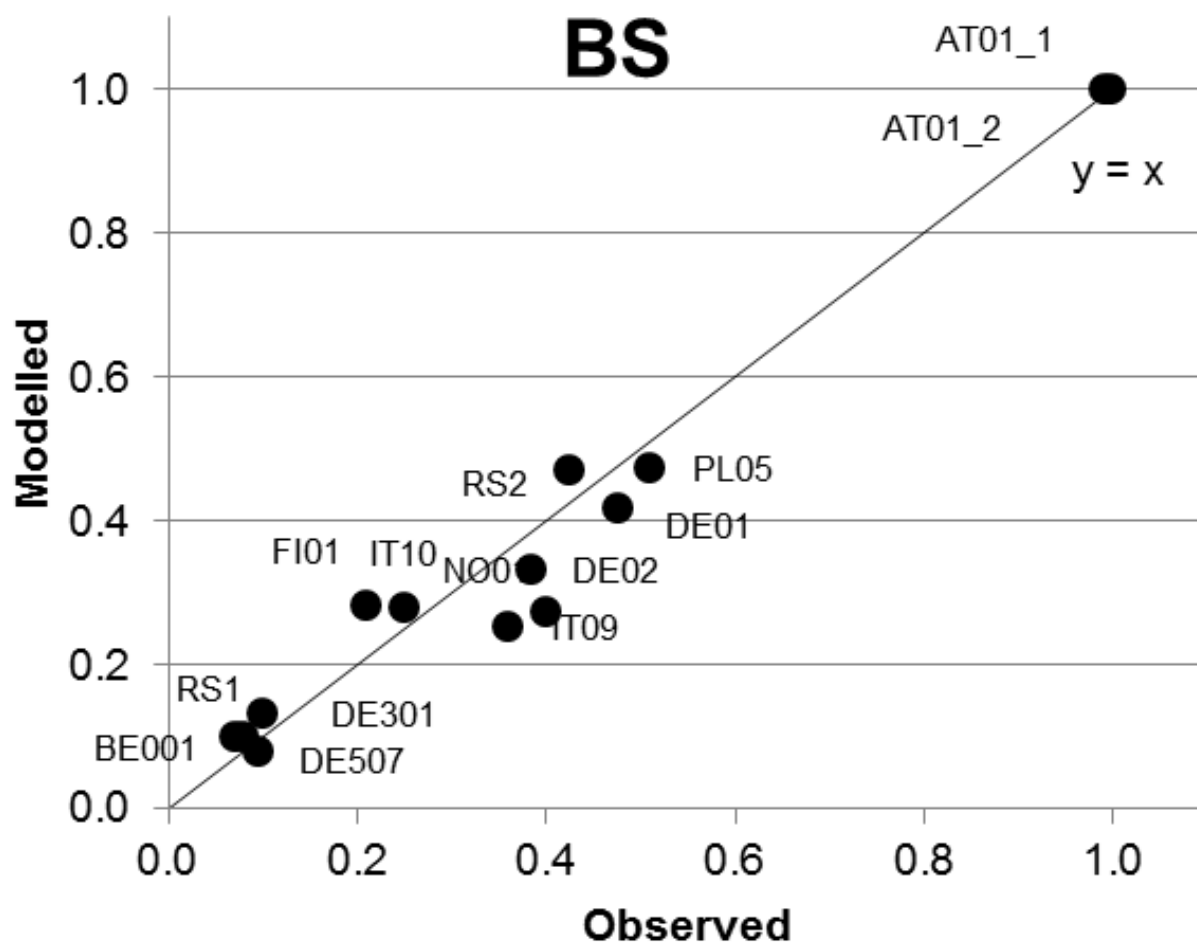
Comparison of modelled to observed values of soil solution pH at 14 sites.



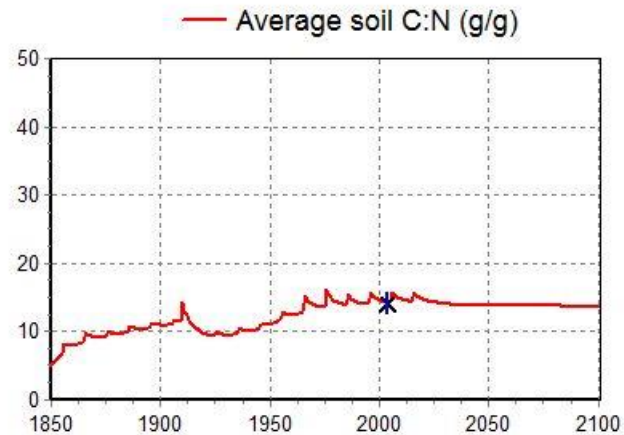
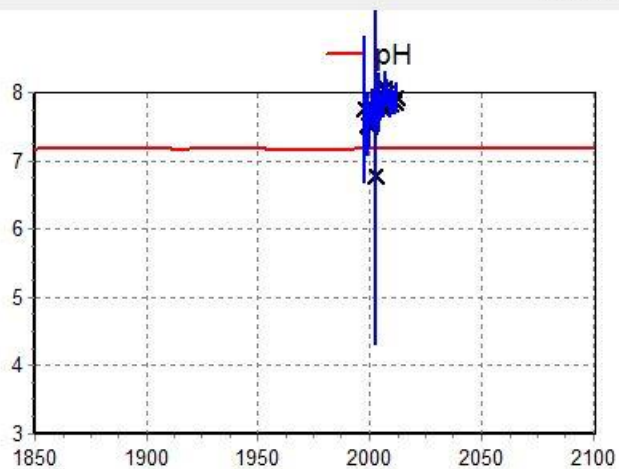
Comparison of modelled to observed values of soil C:N at 14 sites.



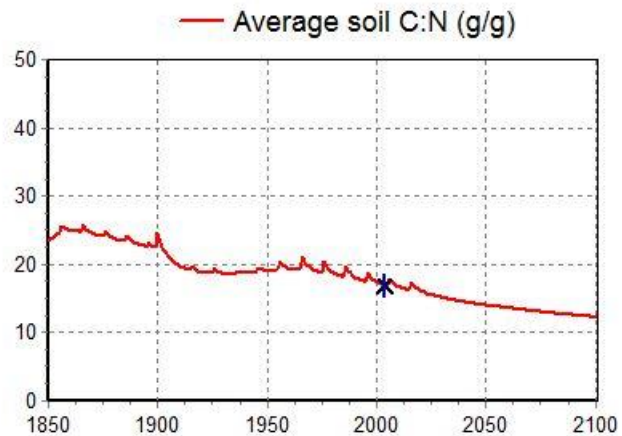
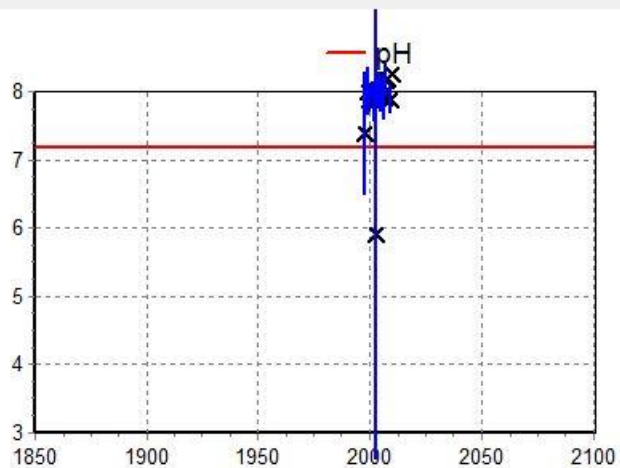
Comparison of modelled to observed values of soil BS at 14 sites.



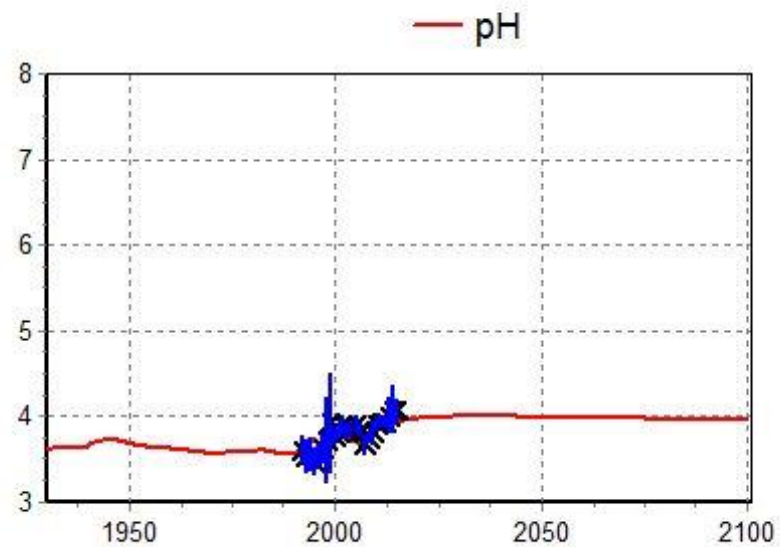
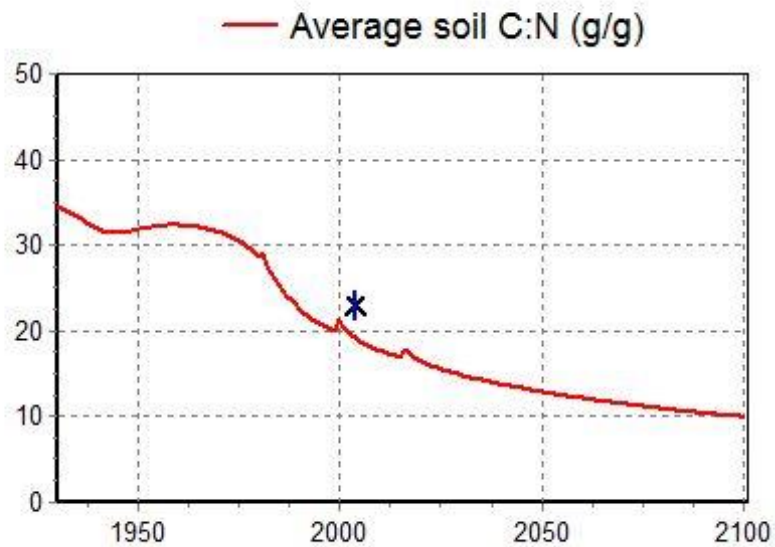
AT01a Zöbelboden IP1



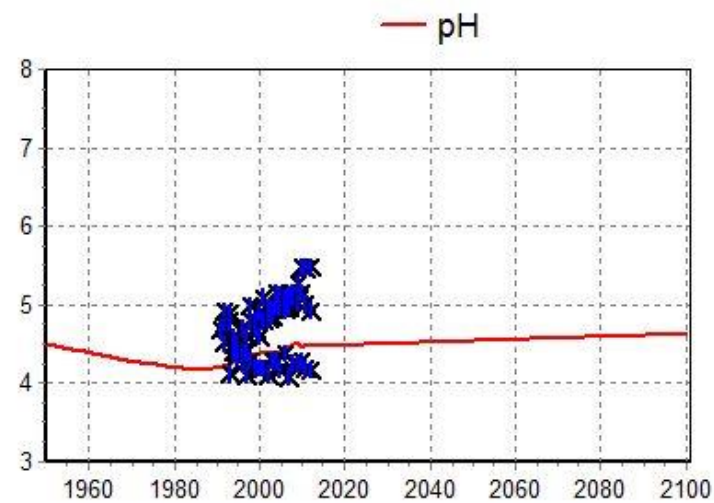
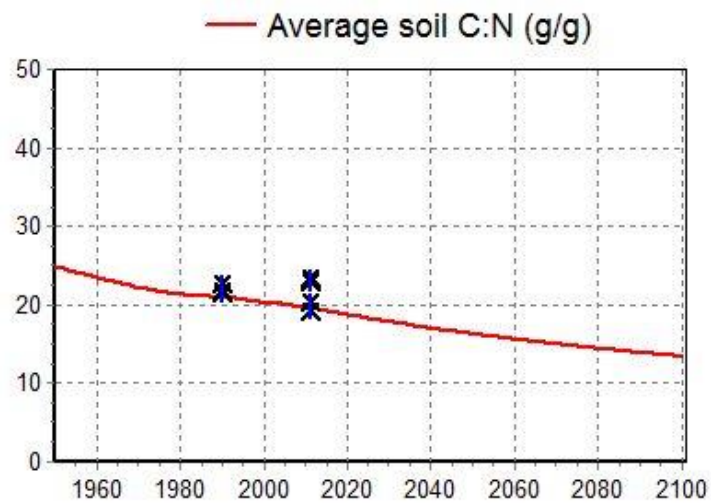
AT01b Zöbelboden IP2



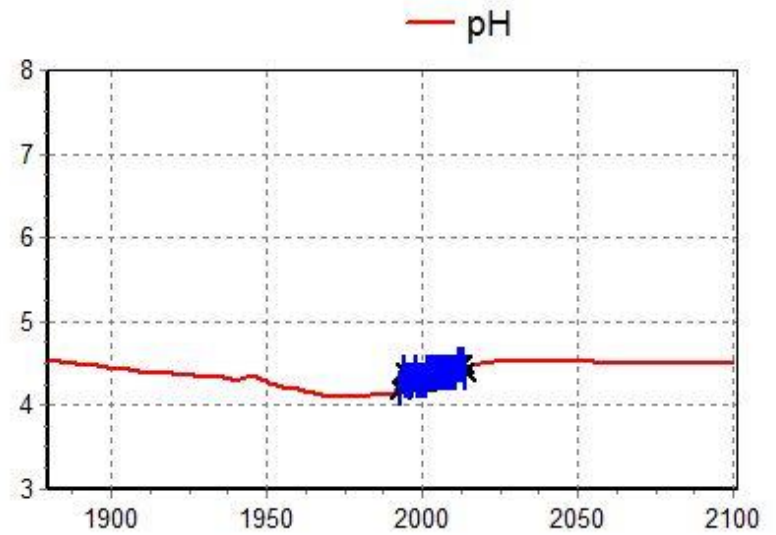
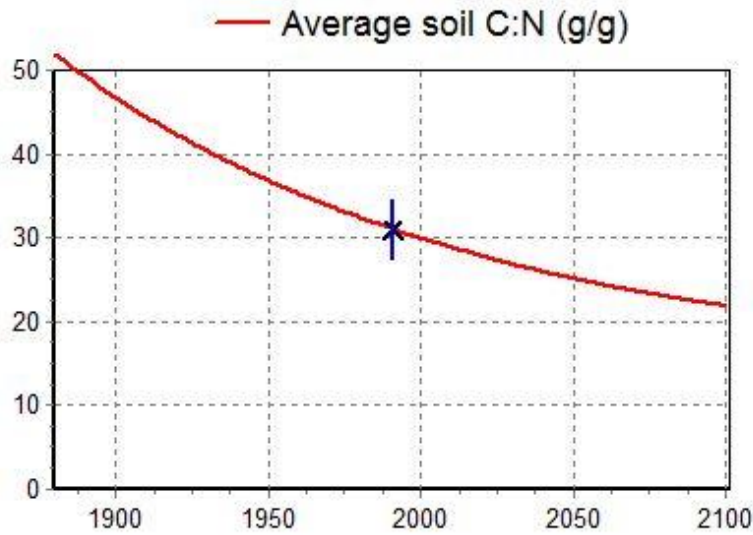
BE01 Brasschaat



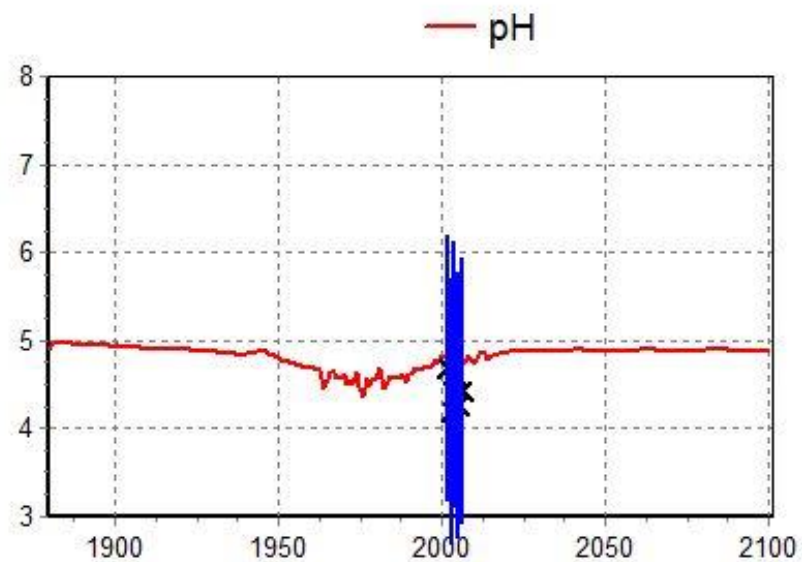
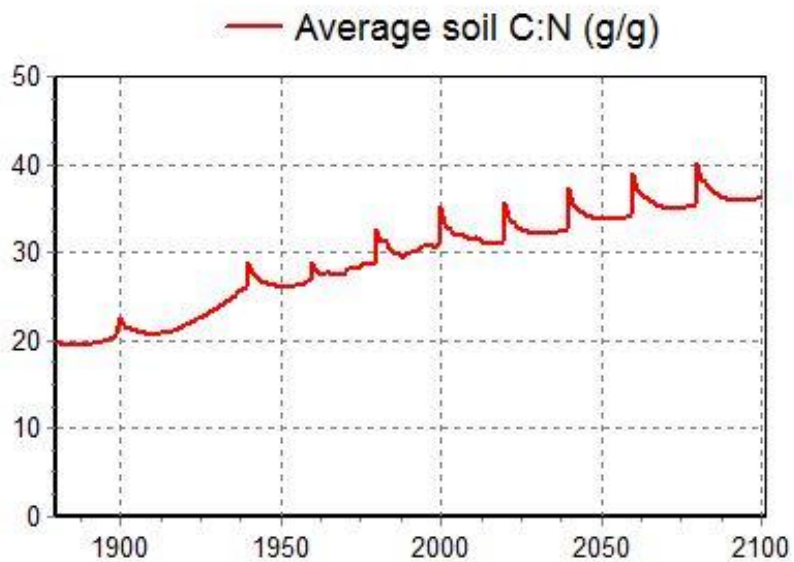
DE01 Forellenbach



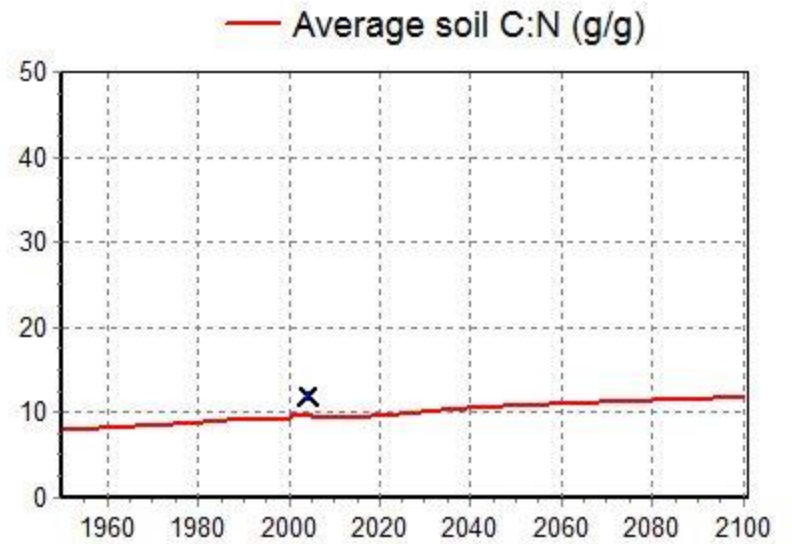
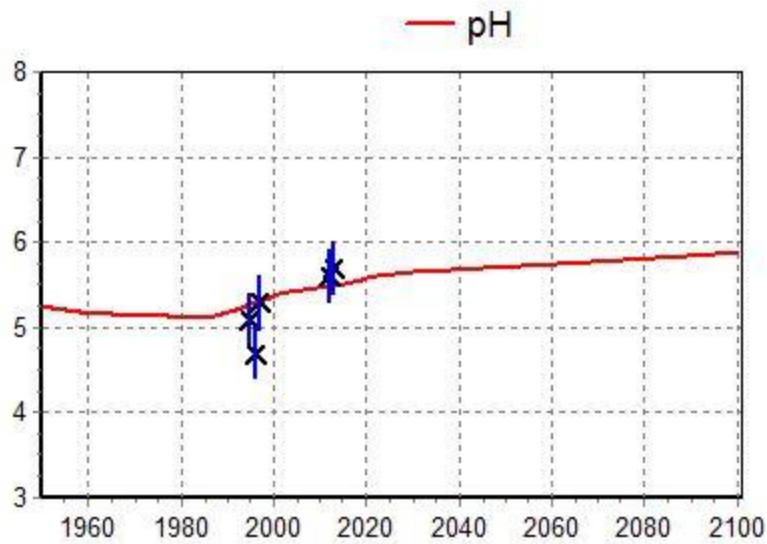
Birkenes NO01



FI01 Evo Valkea-Kotinen

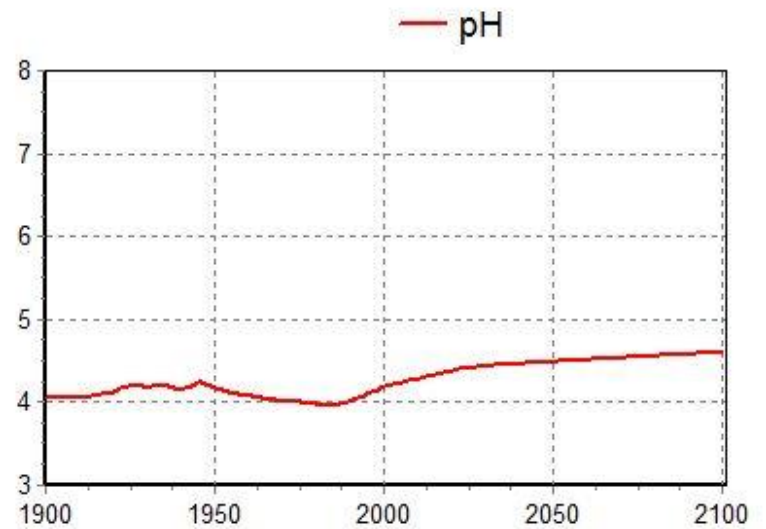
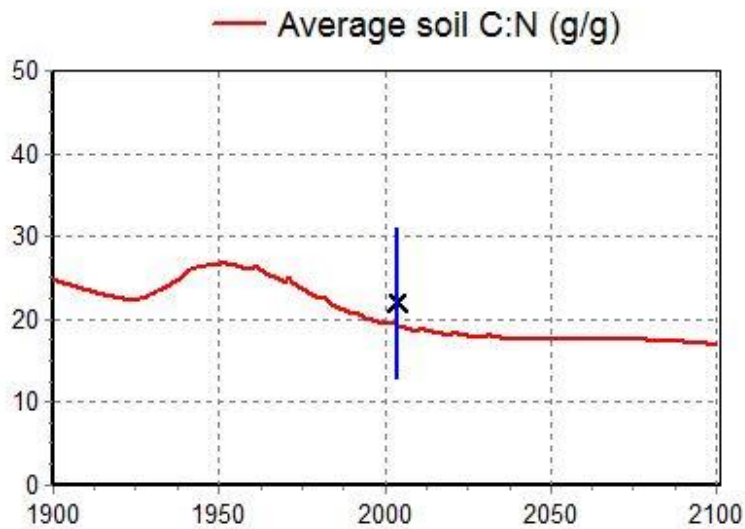


PL05 Borecka

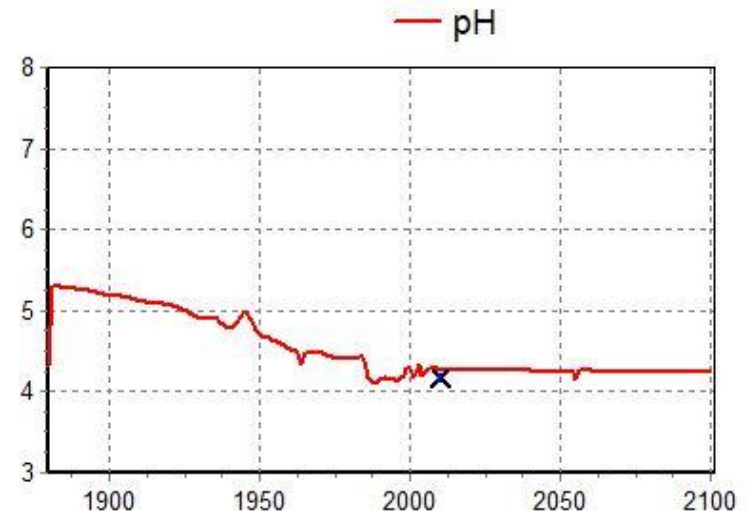
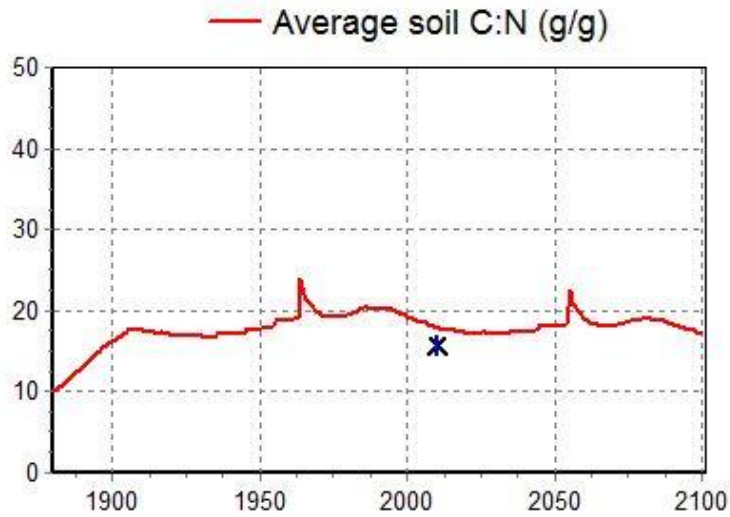


Time development | X-Y graphs |

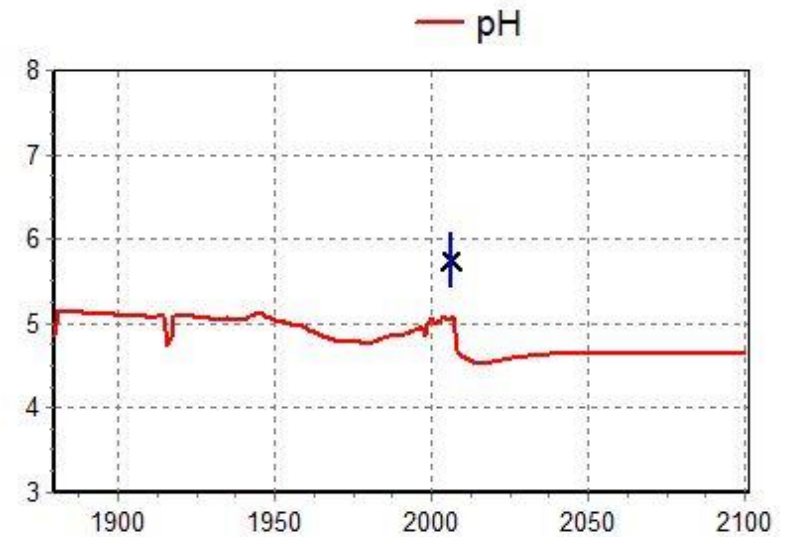
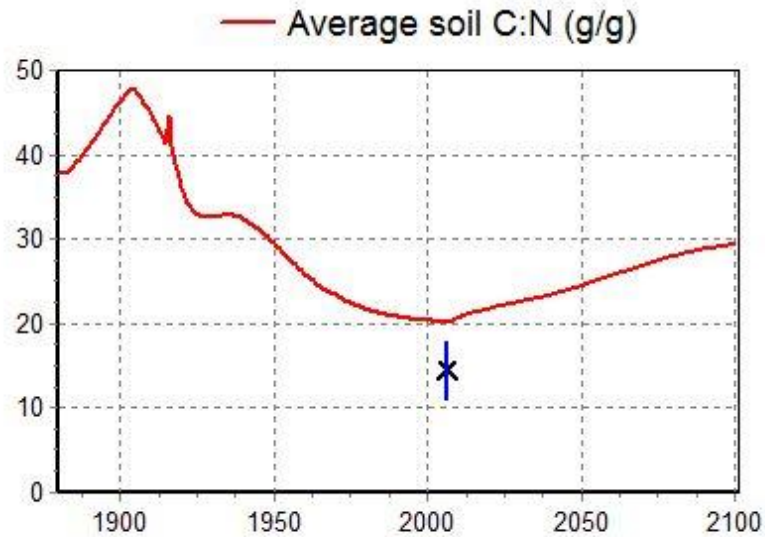
PL SNP Slowinski National Park



RS1 Kopaonik



IT10 LOM1



Next and future tasks

Ndep

- Simulate with deposition scenarios

T, P

- Simulate with climate scenarios

BS, C:N

- Evaluate soil abiotic results



**Thank you for your
interest**

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