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Eutrophication and acidification of german forest ecosystems due to N deposition

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Motivation

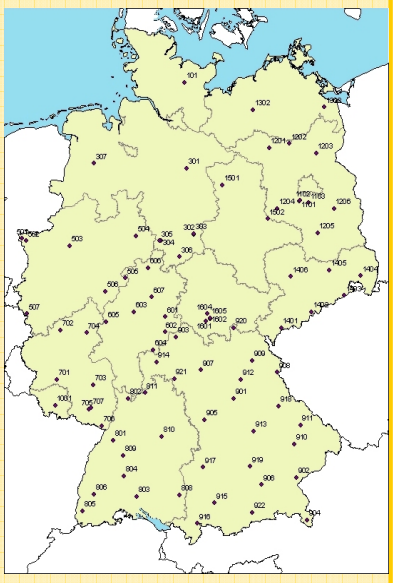
High anthropogenic atmospheric deposition of sulphate, nitrate and ammonium lead to acidification and eutrophication of forest ecosystems, causing problems with forest health and shifts in biodiversity. The deposition reached a peak during the 1980s and a number of political conventions (e.g. Gothenburg Protocol) have been signed, agreeing to reduce industrial emissions. Due to the use of filter systems, sulphate deposition could be significantly reduced in the last decades, whereas nitrogen depositions (NH_4, NO_3) are still on a high level (~ 40 kg N ha^{-1} yr^{-1}).
In this study, a soil acidification module will be implemented into the Modular Biosphere Simulation Environment (MoBilE). MoBilE is a model framework already capable to simulate N and C turnover in forest ecosystems and associated nutrient losses, e.g. N leaching and trace gas emissions (CO_2, N_2O, NO, N_2, CH_4). The aim of the study is to investigate the impact of elevated atmospheric N deposition on forest acidification and eutrophication. This will be done retrospectively (1960-2000) and by application of future deposition and climate scenarios (2000-2030), the latter especially with respect to the evaluation of the recovery potential of forest ecosystems. The simulations will be performed for 86 Level II sites all over Germany.

Database

Input data is available from a detailed database for 86 Level II sites in Germany.
The database contains site-specific information (amongst others) about:

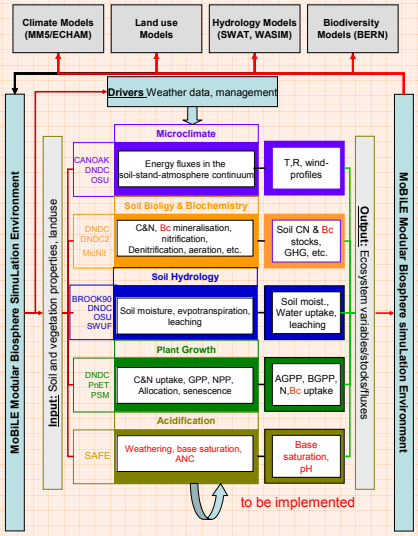
- deposition rates (N, Ca, Mg, K, SO_4)
- pH, base saturation,CEC, bulk density, soil moisture, DOC,$K_{Gibbsit}$
- number and depth of layers
- main tree species at each site
- litterfall

- precipitation, temperature, CO_2 pressure for each layer
- mineralogy

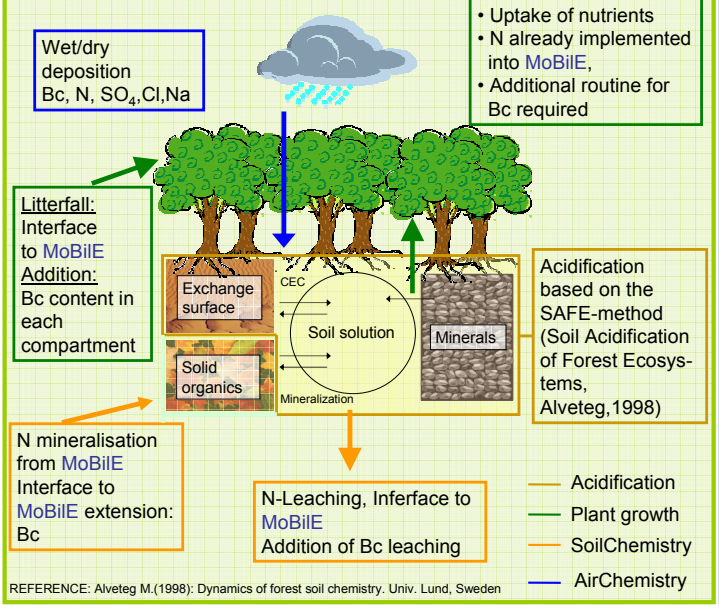


Simu **Mo** dular **Bi** osphere **L** ation **E** nvironment

- modular framework
  - model setup can be designed due to specific research tasks
  - process descriptions for:
    - Microclimate
    - Soil Biology & Chemisty
    - Soil Hydrology
    - Plant Growth
    - Acidification (planned)
  - can be linked with external models:
    - Climate Models
    - Land use Models
    - Hydrology Models
    - Biodiversity Models
- is able to simulate N and C uptake, leaching and trace gas emissions

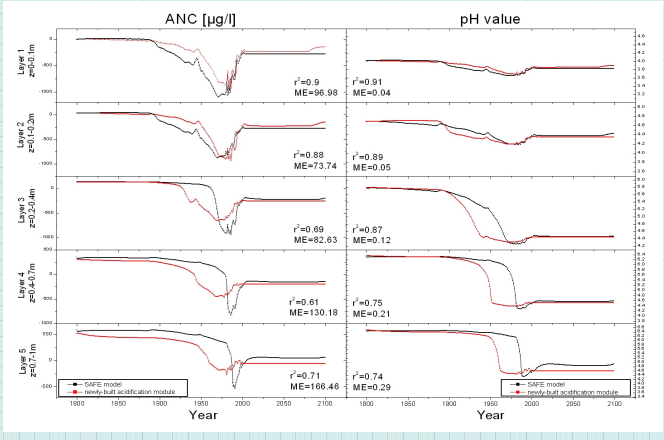


Implementation of a soil acidification module into MoBiLE



REFERENCE: Alveteg M.(1998): Dynamics of forest soil chemistry. Univ. Lund, Sweden

Comparison of the newly-built acidification module to SAFE simulations: preliminary results



Shown is a test simulation at the Solling site for ANC (acid neutralization capacity) on the left, and the pH value on the right hand side. The newly-built acidification module shows good agreement to the SAFE model results in the uppermost two layers. With increasing depth, the simulation results diverge. This can have several reasons: differently simulated water percolation, which mainly influences soil moisture, or plant uptake of base cations.

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