

Systemic modelling of soil functions under the impact of land use

Ulrich Weller (1,4), Sara König (1,4), Birgit Lang (2,4), Stefanie Mayer (3,4), Bastian Stößel (1,4), Hans-Jörg Vogel (1,4), Martin Wiesmeier (3,4), Ute Wollschläger (1,4)

(1) Helmholtz Centre for Environmental Research - UFZ, Soil System Sciences, Leipzig, Germany (ulrich.weller@ufz.de), (2) Senckenberg Museum of Natural History, Görlitz, Germany, (3) TUM Technical University of Munich, (4) BonaRes – Centre for Soil Research, Germany

The increasing demand for food and bio-energy gives need to optimize soil productivity, while securing other soil functions such as nutrient cycling and buffer capacity, carbon storage, biological activity, and water filter and storage. To fully understand these functions, the complex interactions between physical, biological and chemical processes in soil, as well as the feedbacks between these processes, we need computational mechanistic models. With our model, we aim to simulate the impact of different management options on the named soil functions by integrating them within a simplified system. The model operates at the scale of a soil profile (1D) consisting of dynamic nodes, which may represent the different soil horizons, and integrates different processes. In this study, we concentrated on the processes of water dynamics, soil organic matter turnover, and nitrogen cycling to address the soil functions of water storage, carbon sequestration and nutrient cycling.

We simulated the impact of soil compaction affecting the soil structure by reducing the pore space. This directly affects water distribution and storage capacity, which leads to decreasing biological activity and thus lower soil organic matter turnover rates altering the carbon storage capacity. Moreover, the changed distribution of aerobic and anaerobic conditions affects also the mineral nitrogen cycle.

With this example, we show the power of an integrated dynamic model for simulating the impact of land use on soil functions.