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Simulating the impact of land use and climate change on the German soil-carbon, -nitrogen- and -water balance

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The regional application of state-of-the-art soil organic matter models usually lack an explicit representation of landscape hydrology. While the soil water status is generally simulated along the horizontal soil profile, lateral fluxes are not taken into account. Here, we present the coupling of the semi-distributed eco-hydrological model SWIM (Soil and Water Integrated Model) and a soil carbon and nitrogen module. The modelling framework allows the simulation of the impact of process-based simulated hydrological fluxes on soil carbon and soil nitrogen dynamics at landscape scale. While forest and grassland ecosystem remain to a greater or lesser extent constant over time in terms of vegetation cover type and human management arable systems are subject to a high, year-to-year dynamic in terms of soil disturbances, bare or covered soil conditions, different crops and different fertilizer regimes. To account for the variable environmental and human induced conditions of arable soils a crop-sequence generator approach is implemented. The generation of realistic crop rotations is based on statistical distribution of crops in time and space within a reference area (e.g. county). Regionalised climate change scenarios are provided by the statistical climate model STAR. This integrated approach is applied to the whole territory of Germany to assess the impact of climate and land use change scenarios on the soil-carbon, -nitrogen- and -water household of Germany. In respect of sustainability different land management strategies can thus be evaluated and optimised.