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Full uncertainty quantification of a regional N2O, NO, NH3 emission and NO_3 leaching inventory using the biogeochemical model LandscapeDNDC

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Numerical simulation models are increasingly used to estimate greenhouse gas emissions at site to regional / national scale and are outlined as the most advanced methodology (Tier 3) in the framework of UNFCCC reporting. Process-based models incorporate the major processes of the carbon and nitrogen cycle of terrestrial ecosystems and are thus thought to be widely applicable at various spatial scales. Regional inventories require high spatial resolution input data on soil properties, climate drivers and management information.
The acceptance of model based inventory calculations depends on the assessment of the inventory's uncertainty (model structure, initial condition data and parameter induced uncertainties).

In this study we fully quantify uncertainty in regional simulation of the N cycle in arable, grassland and forest soils of Saxony (Germany) using the biogeochemical model LandscapeDNDC. We address model structural uncertainty (MU) by contrasting with Bayes factors two different soil biogeochemistry modules within LandscapeDNDC, the DNDC versus the MeTrx biogeochemistry process description. Initial conditions induced uncertainty (IU) was addressed with the parameter distribution obtained by a Bayesian calibration of soil properties, climate drivers and management practices. The parameter induced uncertainty (PU) was assessed by using a joint parameter distribution for key parameters describing microbial C and N turnover processes as obtained also by a Bayesian calibration study. Once the representative sample size from all parameters, initial conditions and model selection is set, we sampled the different configurations and used these to calculate individual realizations of the regional inventory. The ecosystems considered in this study (forest, arable and grasslands) are given spatially discretized into 8858 polygons (16058 km-2), each representing a unique land use and homogenous soil properties.

For the overall uncertainty quantification we calculated several thousand regional inventories with sampled model configurations, input datasets and parameter distributions. First results with the calibrations, model comparison and uncertainty quantifications for the different ecosystem at site and multisite scale will be presented.