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# Full uncertainty quantification of a regional N2O and $NO_3$ 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, input data and parameter induced uncertainties).
In this study we fully quantify the uncertainty in regional N2O / $NO_3$ inventory predictions from arable soils of Saxony (Germany) using the biogeochemical model LandscapeDNDC. We address model induced uncertainty (MU) by contrasting two different soil biogeochemistry modules in conjunction with two different plant growth descriptions within LandscapeDNDC. Input data induced uncertainty (DU) was addressed by Latin Hyper Cube sampling of soil properties, climate drivers and agricultural management practices. The parameter induced uncertainty (PU) was assessed by using joint parameter distributions for key parameters describing microbial C and N turnover processes as obtained by differenct Bayesian calibration studies for each model configuration. We representatively sampled different parameter vectors from the discrete joint parameter distribution comprising all parameter combinations and used these to calculate individual realizations of the regional inventory. The spatial domain (4042 polygons) was set up with spatially explicit soil and climate information and a region-typical 3-year crop rotation consisting of winter wheat, rapeseed, and winter barley.
For the MU, DU and PU we calculated several hundred regional inventories each to assess the individual uncertainty contributions. For the overall uncertainty quantification we calculated several thousand regional inventories with sampled model configurations, input datasets and parameter distributions. Statistical analysis of the regional simulation results have been used to quantify the overall full uncertainty of the inventory.