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Uncertainty of upland soil carbon sink estimate for Finland

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Changes in the soil carbon stock of Finnish upland soils were quantified using forest inventory data, forest statistics, biomass models, litter turnover rates, and the Yasso07 soil model. Uncertainty in the estimated stock changes was assessed by combining model and sampling errors associated with the various data sources into variance–covariance matrices that allowed computationally efficient error propagation in the context of Yasso07 simulations. In sensitivity analysis, we found that the uncertainty increased drastically as a result of adding random year-to-year variation to the litter input. Such variation is smoothed out when using periodic inventory data with constant biomass models and turnover rates. Model errors (biomass, litter, understorey vegetation) and the systematic error of total drain had a marginal effect on the uncertainty regarding soil carbon stock change. Most of the uncertainty appears to be related to uncaptured annual variation in litter amounts. This is due to fact that variation in the slopes of litter input trends dictates the uncertainty of soil carbon stock change. If we assume that there is annual variation only in foliage and fine root litter rates and that this variation is less than 10% from year to year, then we can claim that Finnish upland forest soils have accumulated carbon during the first Kyoto period (2008–2012).
The results of the study underline superiority of permanent sample plots compared to temporary ones, when soil model litter input trends have been estimated from forest inventory data. In addition, we also found that the use of IPCC guidelines leads to underestimation of the uncertainty of soil carbon stock change. This underestimation of the error results from the guidance to remove inter-annual variation from the model inputs, here illustrated with constant litter life spans. Model assumptions and model input estimation should be evaluated critically, when GHG-inventory results are used for policy planning.
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