



Regional estimation of soil carbon stocks and changes in Germany's forest soils based on the National Soil Inventory to provide the greenhouse gas reporting

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The National Soil Inventory (BZE) serves to Germany's greenhouse gas reporting for the first time with a quantitative assessment of carbon stocks and changes in forest soils. Soil carbon stocks of the organic layer and of the mineral topsoil (30 cm) were estimated on basis of about 1.800 soils sampled from 1987/1992 and re-sampled from 2006/2008 in a nationwide grid of 8 x 8 km. Carbon stocks and changes of the organic layer between both inventories were classified into forest stands and regionalized with CORINE land cover data. To estimate regional carbon stocks of mineral topsoils we designated dominant soil types and parent material for soil formation according to the Revised FAO Legend (1990). The estimated carbon stocks were attributed to dominant soil types according to the Soil Map of Germany 1:1,000,000. Subsequently, the carbon stocks for each soil type was related to Germany's forest area with ATKIS data. The carbon stocks of the organic layer increased under mixed (18.9 ± 5.5 to 19.8 ± 8.4 Mg ha $^{-1}$) and coniferous forests (26.9 ± 4.0 to 28.3 ± 6.2 Mg ha $^{-1}$), but increased under deciduous forest (12.6 ± 3.5 to 11.7 ± 4.5 Mg ha $^{-1}$). Changes in carbon stocks could not be detected. The carbon stocks of the mineral topsoil increased from 61.0 ± 1.0 to 71.1 ± 1.2 Mg ha $^{-1}$, which means an annual increase of 0.5 ± 0.1 Mg ha $^{-1}$. In clayey soils carbon stocks were higher than in sandy soils but larger changes were detected in sandy soils, particularly in the Northern German Lowlands. We assume an accumulation of carbon in the fine fraction with enhanced clay and silt contents. The high carbon sequestration could be caused among others by (i) a higher biomass production caused by an increasing nitrogen input, (ii) a long lasting input of nitrogen and sulphur to become acidified, (iii) a changed forest management, or (iv) a limited microbial activity caused by changed climatic conditions. The estimated carbon sequestration is within the scope of other studies for Central Europe. However, the used method allowed a first approach to estimate regional carbon stocks and changes. There is a wide use of modeling regional carbon stocks but in comparison to those studies the BZE analyzed a large data set. Hence, the data provided a valid sample and enabled a reliable and nationwide estimation of carbon stocks and changes for a certain period. Nevertheless, there are still uncertainties in the estimation due to sampling errors or incomplete datasets.