Geophysical Research Abstracts
Vol. 21, EGU2019-13418, 2019
EGU General Assembly 2019
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Agriculturally used organic soils, their organic carbon stocks and further properties - insights from the first German Agricultural Soil Inventory

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Recently, Germany completed the first Agricultural Soil Inventory in order to improve the greenhouse gas inventory reporting in the sector land-use and land-use change and forestry (LULUCF). In this context, soil organic carbon (SOC) stocks and further chemical and physical properties like SOC content, dry bulk density, total nitrogen (N) content and stocks of all agricultural soils were determined on more than 3100 agricultural sites in an 8 x 8 km raster. All parameters were examined for topsoil (0-30 cm), subsoil (30-100 cm) and the whole profile (0-100 cm). Additionally, the maximum peat thickness was determined and SOC and N stocks were calculated up to the peat base.

The majority of organic soils in Germany is drained and used for agriculture (∼73 %), mainly as grassland. They made up only 5.4 % of the sampling sites, but accounted for around 25 % of the SOC stocks of Germany's agricultural soils. For a more detailed analysis, we developed a classification scheme adapted for strongly disturbed organic soils. The anthropogenic impact was not limited to drainage but frequently also comprised a modification of the soil profile. Of all organic soils, only 46 % could be classified as typical fen and bog peat soils. Further 20 % had either a shallow or thick cover with mineral soil material, while 12 % were transformed to sand mixing cultures. The remaining sites were either very shallow or had a transitory SOC content between mineral and peat soils.

All investigated properties highly depended on the occurrence of mineral horizons and the total peat thickness. Therefore, highest SOC stocks in 0-100 cm depth were found in fen peat, bog peat and shallowly covered organic soils (on average around 600 t SOC ha^{-1}). Considering the total peat thickness, SOC stocks could even be more than twice this value. Especially organic soils with a mineral soil cover contained high stocks in the subsoil, and even sand mixing cultures had much higher SOC stocks than mineral soils. Those soils are often neglected when discussing mitigation options for peatlands, but the high SOC stocks call for studies on their SOC dynamics and potential SOC preservation measures. Furthermore, the high amount of low-SOC and shallow organic soils highlights the dramatic loss of peatlands due to anthropogenic impacts. The results of the German Agricultural Soil Inventory contributed a valuable data set as the sites are systematically distributed and thus, gives an insight into the status and important chemical and physical properties of organic soils. Overall, our findings showed the need for a more diverse perspective on organic soils beyond 'typical' fen and bog peat sites. Moreover, they highlight the importance of organic soils regarding SOC and N stocks which will be threatened without suitable adjustments of the agricultural practices.