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Stocks and changes in organic carbon in Danish agricultural soils – role of bulk density and stone fractions

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Soil organic carbon (SOC) is essential for soil fertility and further represents a global carbon stock with potential to control atmospheric CO_2 concentrations. Due to intense agricultural management, SOC is decreasing in many parts of the world, meaning that the soils act as CO_2 sources rather than CO_2 sinks, which they could have the capacity to be. Therefore, it is important to identify pertinent agricultural management practices that allow for high productivity, but at the same time allow for carbon sequestration and increase in SOC.

In order to document changes in SOC, it is necessary to monitor SOC over decadal time scales, since changes occur slowly and are small as compared with existing stocks. The SOC content in Danish agricultural soils has been monitored at approx. 10-yr intervals (1986, 1997, 2009) since the first systematic national observations in 1986, where soils were sampled from a national 7 km x 7 km grid.

In 2018, a new sampling campaign was conducted from the national 7 km x 7 km grid and soils were analysed for SOC to 1 m depth. The procedures applied in 2018 allowed for more precise relocation of the sampling points from 2009 as compared to precision obtained during the period from 1986-2009. Further, measurements in 2018 included assessment of soil bulk density and stone content in the upper 0-50 cm, which was not measured previously. Thus, one of the aims of the study was to evaluate how more precise point-specific information on bulk density and stone fractions affected the calculated SOC stocks across different soil types and management practices.

The point-specific bulk density measured in 2018 were on average lower than the bulk densities used previously, which were retrieved from a database of texture-based soil classes. The volumetric stone fraction in the upper 0-50 cm was found to be <5% for roughly 90% of the soils, whereas <3% of the soils had stone fractions of >10%. On average, the inclusion of point-specific bulk density and stone fractions lead to approx. 5% lower SOC estimation, with equal approximmately contribution from the two variables.