

Principal drivers of organic carbon stocks in forest soils of the Czech Republic

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Forest soils represent a very important pool of soil organic carbon (SOC) and proper management of these soils can thus mitigate climate change. In this study, we analyzed the major drivers influencing the SOC stocks in temperate forests at national scale of the Czech Republic. We used data from the aggregated database of forest soils of the Czech Republic, containing standardized soil properties compiled from several national-scale soil surveys done in the years 2000-2020. We selected data on locations where the SOC was really determined, i.e. where soil bulk density was measured in the mineral soils and where quantitative sample collection was done for the organic horizons (namely fragmented and humified horizons, F+H). Most of these data originated from the ICP-Forests and Biosoil projects. In total, data on 200 sites were analyzed, with total SOC stocks determined to the depth of 30 cm; in addition, at 169 locations the SOC stock to the depth of 80 cm was also determined. Basic (ANOVA, correlation and regression) and advanced (factor analysis, principal component analysis) statistical methods were employed.

Tree species composition, altitude and forest vegetation zones were found to be the most important drivers of forest SOC stocks. Generally, the total carbon stocks are higher under deciduous forests than under the coniferous ones. Under coniferous forests, the contribution of forest floor (F+H) to the total SOC stock to the depth of 30 cm is higher (around 40%) than under broadleaved and mixed forests (around 20%). Nevertheless, the mineral part of the profiles is still the most important SOC pool. Bigger accumulation of SOC in soil profiles is related to lower temperatures and higher precipitation at higher altitudes, and lower pH reducing the decomposition rate. The strongest effect of pH on SOC accumulation was found in forest floor. In this layer the high SOC stock is generally connected also with lower organic matter quality indicated by higher C/N ratio. Some effect of soil classes was also shown; the highest SOC stocks were in Podzols and Histosols, the lowest in Luvisols and most Cambisols.

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