



SOC storage in Swiss forest soils – driven by climate or historical land-use?

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Soils store the most carbon of all terrestrial ecosystems, with forest soils being particularly carbon-rich (Schmidt et al. 2011; Hagedorn et al. 2010; Jobaggy & Jackson 2000). The C balance of soils might be altered by land-use changes such as in Switzerland, where the forest cover has increased by approximately 22% in the last century (Ginzler et al. 2011).

The objectives of this study were 1) to determine whether historical forest cover change has an impact on soil organic carbon (SOC) storage in Swiss forests, and 2) to estimate the influence of climate on C-stocks in the organic layer and the mineral soil.

In our study, we reconstructed forest cover changes for the last 150 years for the coordinates of 1000 soil profiles from the soil database of the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL). We evaluated historical and modern topographic maps using ArcGIS, classifying current forest sites into permanently (≥ 150 y) forested and newly forested sites (< 150 y). To identify the impact of climate and historic land-use change on SOC storage, we statistically analyzed the influence of the estimated forest ages of the sites and of potentially additional drivers such as topography, climate, and soil properties on SOC stocks.

Contrary to our expectations, our results indicate slightly higher SOC stocks in younger forest sites compared to permanently forested ones. This result could be observed in both organic layer (28,65 vs. 22,23 t C ha⁻¹) and mineral soil (131,38 vs. 113,68 t C ha⁻¹). We attribute the slightly smaller SOC stocks in the younger forests to their inherently higher SOC-stocks, as associated with favorable land previously used for grassland. Moreover, we observed higher SOC stocks under coniferous than under deciduous forest – however, this was only evident in the organic layer, but not in the mineral soil. Soil carbon increased significantly with decreasing mean annual temperature (MAT) and increasing precipitation (MAP), in particular in the organic layer. In addition to climate, we tested a number of other controlling factors such as altitude, pH, soil texture. However, these factors could only explain a small part of the variability in SOC-storage. Nonetheless, we observed a slight influence of clay content in both organic layer and mineral soil as well as a more enhanced effect of pH on C-stocks in mineral soil.

In summary, we conclude that forest age has only a limited effect on carbon stocks stored in Swiss forest soils and that a complex combination of other factors (climate, clay content, altitude) are more important for SOC-storage in Swiss forest soils.