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Site and tree stand specific variations in soil organic matter properties in forest soils

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The quantity and quality of soil organic matter (SOM), SOM pools and related soil properties such as carbon sequestration and water retention are not constant. Instead, SOM exhibits considerable variations that may be amplified through changing climate. In total changes in soil fertility and an increase in plant stress are expected. This is relevant for northwest Europe as well and may have economic and social impacts since functions of forests for wood production, groundwater recharge, soil protection and recreation might be affected.
A comparative investigation is done of selected sites at four watersheds that represent typical forest stands in the region of Luxembourg and South West Germany (funded by the INTERREG IVB-project ForeStClim). The aim is to identify SOM storage and stability in forest soils and its dependence on site properties and interaction with tree stand conditions. Functional C pools in forest soils are investigated using state of the art SOM fractionation schemes. The aim is to identify characteristics of SOM degradability and recalcitrance, respectively, through fractionation of SOM according to density, particle size and chemical extractability and their subsequent analytical characterization. In particular, distribution patterns among different SOM fractions are determined depending on location, tree stand and climatic conditions. These findings are related to selected general soil properties such as pH, OC, Ntot, CEC and texture. Patterns of distribution of SOM in relation to silvicultural use and forest site conditions are presented, as well as similarities and differences among the tree species.
Results of the SOM density fractionation showed differences between Douglas fir, Norway spruce and beech esp. in the top mineral soil horizons (Ah). Differences between coniferous and broadleaf stands and soil horizons were mostly related to the fraction of SOM occluded in particulate organic matter. This fraction was clearly smallest in soil under coniferous stands that also exhibited shallower Ah horizons than deciduous forest stands. Furthermore it was indicated that the distribution over fractions partly depends on soil pH and associated microbial activity which was lower in soil under coniferous stands.