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Insights into soil carbon dynamics across climatic gradients from carbon-pool specific radiocarbon analyses

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Soil carbon constitutes the largest terrestrial reservoir of organic carbon, and therefore understanding the mechanisms and drivers of carbon stabilization is crucial, especially in the framework of climate change. The understanding of the dependence of soil organic turnover in specific carbon pools as related to e.g. climate, soil texture and mineralogy is limited. In this framework, radiocarbon constitutes a uniquely powerful tool that help to unravel carbon dynamics from decadal to millennial timescales. This project combines bulk and pool-specific radiocarbon analyses in the top and deep soil on a wide range of forested soils that span a large climatic gradient (MAT 1.3-9.2°C, MAP ~600 to 2100 mm m-2y-1). These well-studies sites are part of the Long-Term Forest Ecosystem Research (LWF) program of the Swiss Federal Institute for Forest, Snow and Landscape research (WSL). This study aims to combine the insights gained from bulk and pool-specific turnover to environmental conditions and molecular composition of soil carbon. The pools investigated span the mineral-associated (occluded and heavy fractions from density fractionation) and potentially water-soluble (free light fractions from density fractionation and water extractable organic carbon) organic carbon fractions. Pool-specific radiocarbon work is augmented by the measurement of abundance of compounds such as alkanes, fatty acids and lignin phenols on a subset of samples. Initial results show disparate patterns depending on soil type and in particular soil texture, which could be indicative of various stabilization mechanisms in different soils. Overall, this study provides new insights into the controls of soil organic matter dynamics as related to environmental conditions, in particular in specific sub-pools of carbon.