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Global change and soil functions – long-term experiments and alternative approaches

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Soils are practically a non-renewable resource and provide numerous functions for humans and the environment. Both managed and natural soils are under constant development. Soil use changes, however, have the most considerable impact on soil properties. Changes of the nutrient status and productivity were already in the focus of long-term experiments since the middle of the 19th century. From them we learned that equilibrium conditions after management changes in many cases need more than 150 years to be reached. Today, humus dynamics and the impact of soil management on greenhouse gas emission and trapping have gained considerable importance. Investigations in Austria have shown that carbon stocks on average differ by a factor of two between arable land and extensive pasture. Soil tillage regimes and mineral and organic fertilization have additional impacts on humus stocks and dynamics. The long-term changes in humus contents influence different soil functions. Enzyme activities e.g. increase with increasing soil organic matter contents, as does the aggregate stability, just as an example for several physical soil functions. The retention of heavy metals and organic pollutants is heavily influenced by long-term changes of soil organic matter. A variability of a factor of 3 to 5 was observed in long-term experiments in Sweden and Austria.

Another aspect is the long-term development of soils and their properties and especially their impact on ecological soil functions. Soil development leads to significant alterations of soil properties, especially accumulation of soil organic matter (SOM), weathering and secondary soil minerals and influence nutrient dynamics and contaminant retention. Soil development itself is distinctly altered by soil use and management resulting e.g. in different SOM accumulation patterns. Such investigations call for additional methodological approaches as e.g. chronosequence and climosequence approaches, which will be exemplified by studies in the Danube floodplain and the Austrian Alps. The climosequence approach as basis for long-term observations has a significant potential for climate change studies involving SOM dynamics changes.