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Spatial variability of microbial activity and substrate utilization patterns in top- and subsoils under European beech

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The role of subsoils in the global carbon cycle is poorly understood and probably underestimated. This is due to an incomplete understanding of processes and mechanisms that influence carbon storage and decomposition in deeper soil horizons. Microbial communities play an important role in these processes, as their presence, structure and function are crucial for the decomposition and/or stabilization of organic compounds. In this study, carried out in a European beech (Fagus sylvatica L.) forest on a podzolic Cambisol near Hannover, the spatial variability of microbial activity and substrate utilization patterns were investigated in the subsoil. For this purpose, samples were taken from regular grids at dm distances in three soil profiles of 1.85 m depth and 3.15 m length, totaling 192 soil samples. Activities of 9 extracellular enzymes of the C-, S-, P- and N-cycle were determined with a multi-substrate enzymatic assay and for substrate utilization patterns the MicroRespTM method was applied. The results showed a strong decline of microbial activity from topsoil to subsoil. Enzyme activities varied greatly at the dm scale. The correlation of the variability of both microbial activity and substrate utilization patterns with depth and soil parameters such as pH, soil water content, total and dissolved organic carbon was tested with a principal component analysis. Existing dependencies of the variabilities on these parameters help to verify the hypotheses that microbial activity is spatially highly variable in the subsoil and this variability is due to the existence of certain hot spots of substrate availability and that outside these ‘hot spots’ the microbial activity and thus the decomposition of SOM are mainly limited by substrate availability.