Long-term climate change effects on dynamics of microorganisms and carbon in the root-zone

Climate change factors such as elevated CO$_2$ concentration, warming and changes in precipitation patterns have been shown to affect terrestrial carbon (C) cycling. The objective of this Ph.D. project is to track recently assimilated C into belowground compartments to investigate the effects of climate change on belowground C allocation. The impacts of climate change as single and combined treatments were applied to heath/grassland vegetation and the short-term terrestrial C turnover was investigated using in-situ $^{13}$CO$_2$ pulse-labeling. We developed a mobile and low-cost pulse-labeling setup applicable in remote natural environments. We present evidence that our new system works reliably and leads to results similar to former grassland pulse-labeling experiments. Allocation of recently assimilated C into roots and the microbial biomass was often similar among climate treatments, but C allocation patterns into microbial functional groups were treatment dependent. We observed a delayed C allocation into microbes under drought and a faster C flow through the microbial community under elevated CO$_2$ conditions. Especially the importance of actinomycetes in the utilization of recently assimilated C can have major impacts on the C balance under changing climatic conditions. A comparison of C allocation under ambient and simulated future climatic conditions showed that the terrestrial C balance might be changed by reducing soil organic matter mineralization. Our results suggest that the impact of future climatic conditions may change belowground processes involved in C cycling and that heath/grassland soils have the potential to serve as C sinks in the future. To confirm these results, a short-term C balance for the conducted study is needed to reveal if observed C allocation into different microbial communities affects the short-term C balance on the ecosystem scale.