EGU2020-11631, updated on 25 Feb 2021
https://doi.org/10.5194/egusphere-egu2020-11631
EGU General Assembly 2020

Effect of forest soil warming on the rate and temperature sensitivity of microbial C and N processes in a temperate mountain forest

Carolina Urbina Malo[1], Ye Tian[1], Chupei Shi[1], Shasha Zhang[1], Marilena Heitger[1], Steve Kwatcho[3], Werner Borken[3], Jakob Heinzle[2], Andreas Schindlbacher[2], and Wolfgang Wanek[1]
[1]University of Vienna, TER, Department of Microbiology and Ecosystem Science, Vienna, Austria (carolinaurbinamalo@gmail.com)
[2]Department of Forest Ecology and Soils, Federal Research and Training Centre for Forests, Natural Hazards and Landscape, Vienna, Austria
[3]Department of Soil Ecology, Bayreuth Center of Ecology and Environmental Research (BAYCEER), University of Bayreuth, Germany

Despite the intensified efforts to understand the impacts of climate change on forest soil C dynamics, few studies have addressed the long term effects of warming on microbially mediated soil C and nutrient processes. In the few long-term soil warming experiments the initial stimulation of soil C cycling diminished with time, due to thermal acclimation of the microbial community or due to depletion of labile soil C as the major substrate for heterotrophic soil microbes. Thermal acclimation can arise as a consequence of prolonged warming and is defined as the direct organism response to elevated temperature across annual to decadal time-scales which manifest as a physiological change of the soil microbial community. This mechanism is clearly different from apparent thermal acclimation, where the attenuated response of soil microbial processes to warming is due to the exhaustion of the labile soil C pool.

The Achenkirch experiment, situated in the Northern Limestone Alps, Austria (47°34′ 50″ N; 11°38′ 21″ E; 910 m a.s.l.) is a long term (>15 yrs) soil warming experiment that has provided key insights into the effects of global warming on the forest soil C cycle. At the Achenkirch site, we have observed a sustained positive response of heterotrophic soil respiration and of soil CO_2 efflux to warming after nine years (2013), making it an appropriate setting for testing hypotheses about continued or decreasing warming effects at decadal scales. We collected soil from six warmed and six control plots in October 2019, from 0-10 cm and 10-20 cm depth, and incubated them at three different temperatures: ambient, +4, and +10 °C. We measured potential soil enzyme activities with fluorimetric assays, gross rates of protein depolymerization, N mineralization, and nitrification with ^{15}N isotope pool dilution approaches, and microbial growth, respiration, and C use efficiency (CUE) based on the ^{18}O incorporation in DNA and gas analysis. Our preliminary results show that potential enzyme activities of aminopeptidase, N-acetylglucosaminidase, b-glucosidase, and acid phosphatase were stimulated by decadal soil warming by 1.7- to 3.5-fold, measured at the same i.e. ambient temperature. In contrast, the temperature sensitivity (Q10)

remained unaltered between warmed and control soils for all enzyme activities (Q10=1.63-2.28), except for aminopeptidase where we observed a decrease in Q10 by 25% in warmed topsoils (0-10 cm). Aminopeptidase also had the highest temperature-sensitivity (Q10=2.39), causing a decrease of the enzymatic C: N acquisition ratio with warming. These results indicate an increasing investment in microbial N acquisition with warming. We will follow these trends based on results on gross rates of soil C and N processes, allowing to delineate decadal soil warming effects on soil microbial biogeochemistry and to understand their effect on the cross-talk between organic C and N cycling in calcareous forest soils.