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TITLE

Long-term versus short-term warming effects on microbial processes and soil organic matter storage

AUTHORS

Author(s) names Initials (bold presenting author), e.g.

Tom Walker[1], Christina Kaiser[1], Florian Strasser[1], Dagmar Wöbken[1], Niki I. W. Leblans[2,3], Bjarni D. Sigurdsson[3] & **Andreas Richter[1]**

AFFILIATION

Departments and full street addresses should be included.

[1] Department of Microbiology and Ecosystem Science, University of Vienna, Althanstraße 14, A-1090 Wien, Austria

[2] Department of Biology, University of Antwerp, Universiteitsplein 1, B-2610 Wilrijk, Belgium

[3] The Agricultural University of Iceland, Hvanneyri, IS - 311 Borgarnes, Iceland

PRESENTER

Email address of the corresponding/presenting author

andreas.richter@univie.ac.at

PREFERRED FORM OF PRESENTATION (mark with X)

_X_ Oral presentation
__ Poster

SESSION (if you have a preference please mark your 1st choice with 1 and 2nd choice with 2)

__ Session 1 'Habitat'
__ Session 2 'Actors'
__ Session 3 'Interactions'
_1_ Session 4 'Systems ecology'
_2_ Session 5 'Modelling'

KEYWORDS (maximum 5 words)

carbon use efficiency, microbial turnover, thermal adaptations, enzyme efficiency

ABSTRACT (max. 400 words)

Rapid warming in northern ecosystems is predicted to drive massive losses of carbon from soils to the atmosphere, raising concerns that it will create a positive feedback to climate change. There is increasing evidence, however, that the soil heterotrophic microbial community can acclimate to temperature change at time scales from months to years, resulting in attenuating responses of soil organic matter decomposition. Despite this, virtually nothing is currently known about long-term

warming effects on the activity and physiology of microbes, and, through this, the longevity of carbon losses from northern ecosystems. This study was conducted at a unique research site that makes use of natural (geothermal) gradients in soil temperature that have been in place for over 50 years as a natural warming treatment (FORHOT, www.forhot.is). We determined long-term warming effects (+0.5 °C, +1.5 °C, +3 °C and +6 °C) on soil carbon dioxide release, and explored microbial carbon use efficiency, growth, turnover rates and community composition (sequencing of the bacterial/archaeal 16S rRNA genes and fungal internal transcribed spacer, ITS, regions) as mechanisms. We also performed a companion incubation experiment to compare longer-term warming effects on microbial processes to those caused by six weeks of warming of ambient soil to the same temperature increase (+3 °C and +6 °C). We show that while microbial respiration was consistently higher by up to 30% after six weeks of warming, this effect did not persist in soils exposed to 50 years of warming. Microbial carbon use efficiency was not affected by soil warming, neither in the short-term nor long-term, but for different reasons. In the short-term warming treatment, both microbial respiration and growth were increased, while in the long-term microbial respiration and growth were unaltered by elevated temperature. However, under long-term warming, microbial turnover (biomass specific growth) was higher at elevated temperatures compared to ambient controls. This demonstrates that a faster turnover of the microbial community with warming persists even after 50 years. We further explored the underlying mechanism of this response with a microbial C and N turnover model. Interestingly, by simply implementing a positive response of the efficiency of extracellular enzymes to increasing temperature we were able to reproduce the experimentally observed pattern. We present further data linking such long-term thermal acclimation to shifts in microbial community composition, and discuss our findings in the context of warming-driven feedbacks from northern latitude soils to future climate change.