Long-term soil warming decreases soil microbial necromass carbon by adversely affecting its production and decomposition

Xiaofei Liu1,2,3, Ye Tian1, Jakob Heinzle4, Erika Salas1, Steve Kwatcho-Kengdo5, Werner Borken5, Andreas Schindlbacher4, and Wolfgang Wanek1

1University of Vienna, University of ViennaCentre for Microbiology and Environmental Systems Science, Austria
2Doctoral School in Microbiology and Environmental Science, University of Vienna, Djerassiplatz 1, A-1030 Vienna, Austria
3Key Laboratory of Humid Subtropical Eco-geographical Process of Ministry of Education, School of Geographical Sciences, Fujian Normal University, Fuzhou 350117, China
4Department of Forest Ecology and Soils, Federal Research and Training Centre for Forests, Natural Hazards and Landscape – BFW, Seckendorff-Gudent Weg 8, 1131 Vienna, Austria
5Department of Soil Ecology, Bayreuth Center of Ecology and Environmental Research (BAYCEER), University of Bayreuth, Dr.-Hans-Frisch-Straße 1-3, 95448, Bayreuth, Germany

Microbial necromass carbon (MNC) accounts for a large fraction of soil organic carbon (SOC) in terrestrial ecosystems. Yet our understanding of the fate of this large carbon pool under long-term warming is uncertain. Here we show that 14 years of soil warming (+4 °C) in a temperate forest resulted in a reduction of MNC by 11% (0-10 cm) and 33% (10-20 cm). Warming caused a decrease in the production of MNC due to a decline in microbial biomass carbon and reduced microbial carbon use efficiency. This reduction was primarily caused by warming-induced limitations in available soil phosphorus, which, in turn, constrained the production of microbial biomass. Conversely, warming increased the activity of soil extracellular enzymes, specifically N-acetylglucosaminidase and leucine-aminopeptidase, which accelerated the decomposition of MNC. These findings collectively demonstrate that decoupling of MNC formation and decomposition underlie the observed MNC loss under climate warming, which could affect SOC content in temperate forest ecosystems more widespread.