EGU General Assembly 2020

EGU2020-269, updated on 25 Feb 2021
https://doi.org/10.5194/egusphere-egu2020-269
EGU General Assembly 2020

The magnitude of temperature increase matters: how will soil organic mineralization respond to future climate warming?

Jie Zhou[1], Yuan Wen[2], Lingling Shi[1], Michaela Dippold[2], Yakov Kuzyakov[3,4], Huadong Zang[2], Davey Jones[5,6], and Evgenia Blagodatskaya[4,7]

[1]Biogeochemistry of Agroecosystems, Department of Crop science, University of Goettingen, Goettingen, Germany (jackzhou516@gmail.com)

[2]College of Agronomy and Biotechnology, China Agricultural University, Beijing, China

[3]Department of Soil Science of Temperate Ecosystems, Department of Agricultural Soil Science, Georg August University of Göttingen, Göttingen, Germany

[4]Agro-Technological Institute, RUDN University, Moscow, Russia

[5]School of Natural Sciences, Bangor University, Bangor, Gwynedd, LL57 2UW, UK

[6]SoilsWest, UWA School of Agriculture and Environment, The University of Western Australia, Perth, WA 6009, Australia

[7]Department of Soil Ecology, Helmholtz Centre for Environmental Research – UFZ, Halle (Saale), Germany

The Paris climate agreement is pursuing efforts to limit the increase in global temperature to below 2 °C above pre-industrial level. The overall consequence of relatively slight warming (~2 °C), on soil C and N stocks will be dependent on microorganisms decomposing organic matter through release of extracellular enzymes. Therefore, the capacity of soil microbial community to buffer climate warming in long-term and the self-regulatory mechanisms mediating soil C and N cycling through enzyme activity and microbial growth require a detailed comparative study. Here, microbial growth and the dynamics of enzyme activity (involved in C and N cycling) in response to 8 years warming (ambient, +1.6 °C, +3.2 °C) were investigated to identify shifts in soil and microbial functioning. A slight temperature increase (+1.6 °C) only altered microbial properties, but had no effect on either hydrolytic enzyme activity or basic soil properties. Stronger warming (+3.2 °C) increased the specific growth rate (μ_m) of the microbial community, indicating an alteration in their ecological strategy, i.e. a shift towards fast-growing microorganisms and accelerated microbial turnover. Warming strongly changed microbial physiological state, as indicated by a 1.4-fold increase in the fraction of growing microorganisms (GMB) and 2 times decrease in lag-time with warming. This reduced total microbial biomass but increased specific enzyme activity to be ready to decompose increased rhizodeposition, as supported by the higher potential activitiy (V_{max}) and lower affinity to substrates (higher K_m) of enzymes hydrolyzing cellobiose and proteins cleavage in warmed soil. In other words, stronger warming magnitude (+3.2 °C) changed microbial communities, and was sufficient to benefit fast-growing microbial populations with enzyme functions that specific to degrade labile SOM. Combining with 48 literature observations, we confirmed that the slight magnitude of temperature increase (< 2 °C) only altered microbial properties, but further temperature increases (2-4 °C) was sufficient to change almost all soil, microbial, and enzyme properties and related processes. As a consequence, the revealed

microbial regulatory mechanism of stability of soil C storage is strongly depended on the magnitude of future climate warming.