Geophysical Research Abstracts
Vol. 20, EGU2018-9921, 2018
EGU General Assembly 2018

Determining the optimal temperature and precipitation for microbial community development in montane forest ecosystems: PLFA analysis along a 3500 m altitudinal gradient on Mt Kilimanjaro

Anna Gunina (1,5), Joscha Nico Becker (2), Andreas Hemp (3), Luo Yu (4), Davey L. Jones (5), and Yakov Kuzyakov (6)

(1) Kassel University, Environmental Chemistry, Witzenhausen, Germany (guninaann@gmail.com), (2) Department of Soil Science of Temperate Ecosystems, Georg-August-University Göttingen, Göttingen, Germany, (3) Department of Plant Systematics, University of Bayreuth, Germany, (4) Institute of Soil and Water Resources and Environmental Science, Zhejiang Provincial Key Laboratory of Agricultural Resources and Environment, Zhejiang University, (5) School of Environment, Natural Resources and Geography, Bangor University, Bangor, UK, (6) RUDN University, Moscow, Russia

Climate is crucial in controlling and shaping the development of mountain ecosystems, including vegetation and soils. Strong interactions between climatic variables, plant communities and edaphic properties, however, make it difficult to evaluate the main factors controlling soil microbial community structure. The unique elevation gradient of Mt. Kilimanjaro along a 3500 m altitudinal transect was used to determine the effects of a) mean annual temperature (MAT: from +4.7 to +23.7 ^{o}C), b), mean annual precipitation (MAP: from 845 to 3000 mm), and c) edaphic factors on the size and composition of the soil microbial community. Topsoil samples (0-10 cm) were collected from six natural forest ecosystems from 740 to 4190 m a.s.l. Microbial community structure was assessed by phospholipid fatty acid (PLFA) profiling. To contextualize our results, this was supported by a global review of the effects of MAP and MAT on the size of the soil microbial biomass in soils from mountain forest ecosystems in humid continental, humid subtropical, temperate continental, monsoon, and semiarid climates. Our results showed that total PLFA content had a bell shape pattern being maximal at 2120 m (2 μmol g^{-1} soil), which is explained by an optimal combination of temperature (+12 ^{o}C) and precipitation (3000 mm). The minimum PLFAs content (0.2 μmol g^{-1} soil) was found at the location with the lowest temperature and productivity (4190 m). The meta-analysis showed that PLFAs content peaked in mountain forest soils worldwide around 2000 m independently from biogeographical region. Thus, we conclude that a bell shaped distribution of PLFAs with a peak around 2000 m a.s.l. may be a general pattern in mountain forest ecosystems. Microbial communities were dominated by Gram-negative bacterial (G-) PLFAs (25-40 %), which determined the distribution of total PLFAs along the elevation gradient. Contents of Gram-positive (G+) bacteria decreased with MAP and MAT with elevation. In contrast, fungi and actinomycetes followed a U-shaped distribution, reflecting their adaptation to low precipitation, MAT and low nutritional status of the soils at the highest elevation. Principal component analysis of PLFA distribution along the altitudinal gradient revealed distinct microbial communities for the low (below 3000 m) and high elevations (above 3000 m). Soil parameters (C, N, pH) and climatic variables (MAT, MAP) together explained 44 % of the total variance (partial RDA), whereas soil parameters alone explained 19 % and climatic variables (MAT, MAP) alone explained only 2 %. Consequently, we conclude that the effect of climate on the formation of microbial community structure in mountain regions is largely indirect and is mediated through plant productivity and soil properties.