Geophysical Research Abstracts
Vol. 17, EGU2015-15741, 2015
EGU General Assembly 2015

Microbial utilization of litter carbon under the effect of extreme weather events

Steffen Heinrich (1), Yakov Kuzyakov (2), and Bruno Glaser (3)

(1) Department of Agroecosystem Research, University of Bayreuth, Germany, (2) Department of Soil Science of Temperate Ecosystems, Georg-August-University of Göttingen, Germany, (3) Department of Soil Biogeochemistry, Institute of Agricultural and Nutritional Science, Martin-Luther University Halle-Wittenberg, Germany

Climate change is expected to not only lead to an increase of average annual temperature but also to increase the frequency of extreme meteorological events. For example, extreme summer-droughts followed by heavy rainfall events are likely to increase. This may change SOM quality, composition, microbial community functioning and thus C turnover in temperate forest ecosystems. Therefore, we performed a tracer experiment in the “Fichtelgebirge” (Northern Bavaria) to verify the influence of strong drying followed by intensive rewetting on the microbial community structure and decomposition of litter-derived 13C by individual microbial groups.

In 2010, sheltered plots with artificially simulated drought, those with additional irrigation and control sites under natural conditions were established at a Norway spruce forest. At each plot, we added 13C enriched spruce litter to simulate annual litter fall. Thereafter, we assessed the effect of extreme weather events on microbial community structure by phospholipid fatty acid (PLFA) analysis. In addition, we analyzed the 13C incorporation into bulk soil, microbial biomass and PLFA of the organic horizon and the mineral soil up to 10 cm. Additionally respired CO_2 was quantified by closed chambers.

Drought reduced the microbial biomass only in the organic horizon, while in the mineral soil the microbial abundance did not decrease compared to the control and irrigated plots. The decrease in microbial biomass in the organic horizon of the drought plots resulted also in a strongly reduced incorporation of litter derived C: Incorporation of litter 13C was a magnitude of three lower in the drought plots compared to the control and irrigation plots. Furthermore, after the drought period of 90 days the proportion of 13C in CO_2 from soil respiration was reduced by about 95% on the drought plots compared to the control and irrigated plots. This is in agreement with the reduced degradation of litter derived C and thus a reduced C turnover under dry conditions.
PLFA analysis showed high amounts of gram positive and gram negative bacterial as well as fungal fatty acids, whereas actinomycets and protozoa represented minor groups. An increased ratio of the cy-PLFA to (16:1w7c+18:1w7c) on the drought plots of the organic layer suggest that bacteria suffered from water stress. In comparison to other microbial groups only the fungi were not depleted by drought showing the advantage of hyphae in resisting unfavourable environmental conditions compared to the single cells organisms. Both, in the organic horizon and the mineral soil, most 13C was incorporated into the gram negative bacteria and into fungi, whereas actinomycetes and protozoa showed the lowest incorporation. This tendency is even enhanced for the drought plots. Gram positive bacteria showed a low incorporation of litter derived C despite their high abundance, which reflects their general preference for old SOM-derived C sources.

Combining 13C-labeling and 13C partitioning in microbial and SOM pools provides a powerful method combination to understand the mechanisms of SOM turnover especially those which are microbially controlled. This will fundamentally improve our understanding of C pool dynamics under changing environmental conditions like extreme whether events.