Microbial fingerprints in terrestrial carbon cycling

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Soil organic matter is the largest terrestrial carbon pool and high ages of soil carbon suggest great stability of this carbon. Land use change mainly from forests and natural grasslands to agricultural fields, however, constantly depletes this carbon pool and the emerging "slown in –fast out paradigm" contradicts high soil carbon stability. The land use driven CO_2 flux contributes to about 25% of anthropogenic CO_2 emissions and accelerates climate change. At the moment it is not well understood how the remaining soil carbon will react under climate change.

In order to better understand the dynamics of soil carbon we used vegetation change experiments from C3 crops to C4 crops tracing the plant derived carbon flow into soil carbon and dissolve organic carbon. We used a variety of compound specific ^{2}H, ^{13}C and ^{14}C measurements of soil microbial phospholipid fatty acids, leave waxes and pyrolysis products to investigate the molecular turnover of these compounds. We demonstrated that intrinsic stability and recalcitrance of soil organic matter is not the main determinant for soil carbon stability. Our results suggest that spatial separation between decomposers and their resources is controlling soil carbon stability.

Consequently we incubated ^{13}C enriched biochar in soil to investigate the stability of these recalcitrant compounds. Biochar amendments are suggested to be able to compensate for land use driven carbon losses and to increase the soil fertility. However, our results indicate that biochar is decomposed in a decadal timeframe and that mainly fungi are involved in this process. The turnover time greatly depended from the type of biochar which suggest that specific biochars could be "designed" to create a transient carbon pool in soil for carbon storage.