Geophysical Research Abstracts
Vol. 16, EGU2014-6911, 2014
EGU General Assembly 2014

Assessing the soil microbial carbon budget: Probing with salt stress

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The amount of carbon stored as soil organic matter (SOM) constitutes a pool more than double the size of the atmospheric carbon pool. Soil respiration represents one of the largest fluxes of carbon between terrestrial ecosystems and the atmosphere. A large fraction of the CO_2 released by soils is produced by the microbial decomposition of SOM. The microbial carbon budget is characterized by their carbon use efficiency, i.e. the partitioning of substrate into growth and respiration. This will shape the role of the soil as a net source or sink for carbon. One of the canonical factors known to influence microbial processes in soil is pH. In aquatic systems salinity has been found to have a comparably strong influence as pH. However salinity remains understudied in soil, despite its growing relevance due to land use change and agricultural practices.

The aim of this project is to understand how microbial carbon dynamics respond to disturbance by changing environmental conditions, using salinity as a reversible stressor. First, we compiled a comparative analysis of the sensitivity of different microbial processes to increasing salt concentrations. Second, we compared different salts to determine whether salt toxicity depended on the identity of the salt. Third, we used samples from a natural salinity gradient to assess if a legacy of salt exposure can influence the microbial response to changing salt concentrations. If salt had an ecologically significant effect in shaping these communities, we would assume that microbial processes would be less sensitive to an increase in salt concentrations.

The sensitivity of microbial processes to salt was investigated by establishing inhibition curves in order to estimate EC_{50} values (the concentration resulting in 50% inhibition). These EC_{50} values were used to compare bacterial and fungal growth responses, as well as catabolic processes such as respiration and nitrogen mineralisation. Initial results suggest that growth related measures are more sensitive to salinity than catabolic processes. This could be an indication that at higher salt concentrations, the microbial community allocates less carbon towards growth, resulting in reduced carbon use efficiency. We also found that microbial processes show different sensitivities depending on the kind of salt used in the experiment. Currently we are making comparative analyses to determine whether osmotic strength or specific ion concentrations best explain toxicity. In addition we are in the process of investigating if pre-exposed communities from naturally saline soils have developed a higher tolerance to salt.