Geophysical Research Abstracts
Vol. 16, EGU2014-10031, 2014
EGU General Assembly 2014

Investigation of organic carbon transformation in soils of dominant dissolved organic carbon source zones

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Over the past 20 years both a decrease in soil organic matter (SOM) and an increase in the dissolved organic carbon (DOC) concentrations in surface water bodies, including drinking water reservoirs, have been recorded in the northern hemisphere. This development has severe consequences for soil fertility and for drinking water purification. As both processes occur simultaneously, we assume that microbial SOM degradation, which transforms SOM into CO_2 and DOC, is a possible source of the additional DOC in the surface water. In addition we speculate that both processes are initially triggered by physical mechanisms, resulting in a modification of the organic matter solubility equilibria and thus in higher SOM availability and DOC mobilization. The general hypothesis of the study is therefore that SOM loss and DOC increase are combined consequences of enhanced microbial degradation of SOM and that this is a result of climate variations and global change, e.g. the increase of the temperature, the alteration of the water regime (i.e. increase of the frequency of drying and rewetting cycles and a higher number of heavy rain events), but also the decrease of the atmospheric acid deposition resulting in an increase of soil pH values.

The general goal of the study is the identification of the dominant processes and controlling factors involved in soil microbial carbon turnover and mobilization of DOC in soils from catchment areas that contribute DOC to the receiving waters and the downstream Rappbode reservoir, which showed a pronounced increase in DOC concentration in recent years. This reservoir is the source of drinking water for about one million people in northern Germany.

Preliminary screening experiments, consisting of 65-day soil batch incubation experiments, have been conducted in order to select the parameters (and the parameter ranges) of relevance for further in-depth experiments. During the experiments, different soil systems were exposed to different temperatures, pH, and water contents. The extractable DOC and the mineralization products (CO_2) were monitored in order to obtain the mass balances of SOM turnover for the different systems. In addition, for each system the aromatic character of the DOC extracted was evaluated by analyzing the specific UV absorbance (SUVA) at 254 nm. Results from the preliminary experiments will be presented. All the environmental drivers which were studied influenced both organic matter degradation and DOC mobilization, which suggests a positive correlation between the two processes. The results of the screening experiments will be the basis for the experimental design of further experiments studying the mechanisms of these observed changes in detail.