Geophysical Research Abstracts
Vol. 15, EGU2013-4508, 2013
EGU General Assembly 2013

Experimental soil warming alters the sources of DOM in alpine treeline soils

Frank Hagedorn (1), Melissa Dawes (2), and Christian Rixen (2)

(1) Swiss Federal Institute for Forest, Snow and Landscape Research, Biogeochemistry, Birmensdorf, Switzerland (hagedorn@wsl.ch), (2) WSL Institute for Snow and Avalanche Research SLF

The aim of our study was to quantify the sources of DOM in alpine treeline soils and to estimate how soil warming affects DOM generation. In order to track new carbon through the plant and soil system, we made use of a 9-year CO_2 enrichment experiment, in which the added CO_2 carried another 13C signature than normal air and provided a 13C-label for new plant-derived C. The CO_2 enrichment study was combined with a six year long experimental soil warming by 4°C with heating cables on the soil surface. This approach gave insights into the effects of soil warming on the production of DOM from 'new' (root and litter) and old (SOM) sources.

Our 13C tracing showed that significant amounts of recent assimilates were allocated to the belowground as soil-respired CO_2 consisted approximately to 60% of new, less than 9 year-old C. In DOM of the organic layer at 5 cm depth, however, the contribution of new plant-derived C was less than 30%; in mineral soil's DOM the 13C label was even not detectable. The 13C-based mean ages of DOC in the Oa horizon were 22 to 30 years and four times greater than that of the litter layer. Therefore, DOM in the Oa horizon was dominated by 'older' C, while new C from throughfall, fresh litter, and root exudates contributed little to Oa-DOM. We attribute the small leaching rates of new DOM to (1) low input of fresh organic matter as compared to the total soil organic matter in alpine ecosystems; (2) rapid biodegradation of labile new DOM such as root exudates.

Experimental soil warming increased soil CO_2 effluxes instantaneously and continuously for six years (+45%; +120 g C m y-1). In contrast, DOM leaching showed only a negligible initial response (<+10%), indicating that DOM production is less temperature sensitive than soil respiration. One reason might be that the production and consumption of DOM were tightly balanced, resulting in small net changes in DOM leaching. Another explanation was given by the 13C tracing, showing that soil warming decreased the fraction of new C in DOM. Potential mechanisms for the reduced inputs of from new C in warmer soils are a bypassing of the dried-out litter layer by percolating soil water or a decreased rhizodeposition by plants due to a higher nutrient availability.

In summary, our results show that DOM of alpine soils is dominated by older C with soil warming increasing this fraction. With respect to C fluxes, DOM leaching responds less sensitive to soil warming than soil respiration.