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Sources and production of dissolved organic matter in alpine ecosystems

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Although we know a lot about DOM fluxes and characteristics, large uncertainty exists about the formation and origin of DOM in soils. In this study, we elucidated DOM sources by enriching treeline ecosystems on undisturbed soils for five years with ^{13}C-depleted CO_2 and by following the fate of ^{13}C-labelled photosynthates in the plant and soil system. In addition, we conducted a short-term in situ warming experiment with heating cables to estimate the temperature responsiveness of DOC production and the production rate of DOC. Our ^{13}C tracing showed that significant amount of recent assimilates were allocated to the belowground as soil-respired CO_2 consisted approximately to 50% of new C. In DOC of the organic layer at 5 cm depth, however, the contribution of new less than 5 year-old plant-derived C was less than 15%; in mineral soil's DOC the ^{13}C label was even not detectable. This implies that organic layer DOC was dominated by 'old' C and that potential sources for new DOC such as throughfall, fresh litter and root exudates were less important. The leaching of new plant-derived DOC from the organic layer amounted only 1-2 g of DOC $m^{-2}y^{-1}$, which was less than 1% of net primary productivity and less than 2% of the C allocated to the belowground. Radiocarbon measurement support that the major fraction of DOC leached from the organic layer is several decades old. The experimental warming by 8˚C for one week showed an immediate response of soil respiration, but unchanged DOC fluxes during repeated leaching events. The lacking response of DOC fluxes to temperature indicates that the microbially-driven DOC production rate is much smaller as compared to the potentially leachable DOC pool. In summary, our 13C-tracer based results show that older more humified soil organic matter pools are the major source of DOC in soils and that the production rate of DOC is much smaller than the potentially leachable DOC pool.