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Effect of pattern formation on C and N turnover heterogeneity in initial soils

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The formation of vegetation patterns and hydrological processes, among others, result in soil heterogeneity in newly exposed land surfaces. We studied the effect of these developling structures on carbon and nitrogen trunover in soils of the artificial catchment Chicken Creek (Schaaf et al. 2011, 2012).
Substrates with different physical and geochemical properties in combination with different labelled plant litter materials were studied in a microcosm experiment over a period of 80 weeks.
Main objectives of the microcosm experiment were to determine the transformation processes of C and N from litter decomposition within the gaseous, liquid and solid phase, the interaction with mineral surfaces and its role for the establishment of biogeochemical cycles. The microcosm experiments were established in a climate chamber at constant 10 °C. In total, 48 soil columns (diameter: 14.4 cm; height: 30 cm) were filled with two different quaternary substrates (sand and loamy sand) representing the textural variation within the catchment at a bulk density of 1.4-1.5 g cm-3. The columns were automatically irrigated with artificial rainwater four times a day with 6.6 ml each (corresponding to 600 mm yr-1). The gaseous phase in the headspace of the microcosms was analyzed continuously for CO_2 and N2O concentrations. C and N transformation processes were studied using 13C and 15N labelled litter of two different plant species occurring at the catchment (Lotus corniculatus, Calamagrostis epigejos) that was incorporated into the microcosm surface.
By including litter from species with wide distribution within the catchment and soil substrates representing the main variation types of the sediments used for catchment construction we were able to characterize the general function of these sub-patches within the catchment with respect to litter decomposition, soil solution composition, DOC and nutrient leaching, and impact on the mineral soil phase. The results suggest that initial differences in substrate composition in combination with invading vegetation leads to the development of patterns with different biogeochemical process intensities within the catchment. These patterns are not mere additive effects of substrates plus litter, but reflect differences in element cycling.

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