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Precipitation regime effects on the transport of microbial-derived organic matter from soils to surface waters

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In the last decades, decreases in soil organic matter (SOM) content and increases of dissolved organic carbon (DOC) concentrations in surface water bodies have been recorded in the northern hemisphere. These have severe consequences for soil fertility and for drinking water purification, respectively. We hypothesize that microbially degraded SOM is a potential source of the additional DOC in the surface water. Recently, rain events have become more extreme, resulting in longer droughts and more intense rain events. These changes in the precipitation regime may increase the input of DOC into surface waters, which occurs mainly directly after heavy rain events. Therefore, our interest was to evaluate the role of variations of the water regime on the mobilization of the DOC from soil organic matter to soil solution. Flow-through column experiments were conducted under extreme precipitation scenarios (from continuously wet to pronounced drying and rewetting) in the laboratory in order to test how fluctuation in the water content influences DOC concentration and composition in the leachates. In our experiment we analyzed both soil respiration and DOM mobilization and found that the increased DOM mobilization after heavy rain events was also an effect of increased microbial activity after the drought stress was relieved. Furthermore, we considered that an important contribution to DOC formation and export may come from microbial processing of microbial biomass residues, residing within the particulate organic matter (POM) fraction. Therefore our aim was to link the necromass contribution to the exported DOC by characterizing DOC leachates of the soil columns at the molecular level and comparing them to fractions of bacterial DOC and POC obtained from an Escherichia coli pure culture, by using ultra-high-resolution methods such as Electrospray Ionization and Matrix assisted laser desorption/ionization Fourier transform ion cyclotron resonance mass spectrometry (ESI-FTICR-MS and MALDI-FTICR-MS, respectively). The results help to relate the origin of organic matter to typical chemical composition patterns and to allow quantification of the relative contributions of plant and microbe-derived material to NOM and how they are affected by the different water regimes. The results of this experiment consent to link SOM degradation and DOC mobilization and to understand the role of water regime variations for these processes.