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Storm dissolved organic matter : surface and sub-surface erosion controls its composition

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In headwater catchments, flood events are responsible for exportation of the major part of DOM (dissolved organic matter) during the hydrological year. During these hot moments, the increased flow at the outlet is accompanied with an increase of DOM concentrations, implying the mobilisation of additional DOM sources which could have a different composition than DOM exported during base-flow. Molecular analysis performed on samples coming from the outlet of the Kervidy-Naizin catchment, an agricultural catchment located in France (Critical Zone Observatory AgrHyS) revealed a modification in the distribution of lignin compounds during flood events. This DOM, less biodegraded, could be produced by partition between particulate and dissolved phases when the soil/water ratio is low, that is to say when soil particles are isolated in water. The evolution of DOM composition during storm events has been assumed to reflect a combination of in-stream and in-soil erosion processes. So how soil erosion could be responsible for production of less degraded DOM? And is the composition of soil DOM modified during a storm event?
Those questions were investigated during two flood events, by sampling soil solutions with high frequency in riparian soils equipped with zero-tension lysimeters in the Kervidy-Naizin catchment. In the same time stream DOM was sampled at the outlet of the watershed and runoff were investigated. Samples have been filtered at 0.2μm, analysed for DOC and freeze-dried for molecular analysis (thermally assisted hydrolysis methylation - gas chromatography / mass spectrometry). The hydraulic gradient was monitored every 15 minutes using piezometers implemented in the riparian soils and higher up in the toposequence.
At the beginning of the events, hydraulic gradient increased rapidly and stayed high during several days. Modification of DOM composition in soil solution were recorded during the hydraulic gradient rise with an increase in the proportion of less degraded and more hydrophobic molecules than during base-flow conditions. Flood events were also responsible for contribution to the river of high quantity of runoff solutions containing a high amount of POM, and DOM in high quantity with the same characteristics than soil solutions. In river, the modification of DOM quality is also recorded short time after its appearance in soil solutions.
For the first time, the composition of soil solution DOM has been investigated during flood events. Results evidence the concomitant evolution of hydraulic gradient, DOM concentration and composition in runoff, soils solutions and stream water. These results highlight the contribution of surface and sub-surface erosion in the production of storm stream DOM.