Geophysical Research Abstracts
Vol. 13, EGU2011-5000, 2011
EGU General Assembly 2011

Identification of the transport pathways of dissolved organic carbon from soil to surface water.

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All natural waters contain organic matter in the form of dissolved organic matter (DOM) and particulate organic matter (POM). The dissolved (<0.45μm) fraction is of large environmental significance in the aquatic system. Over the last two decades, increasing concentrations of dissolved organic carbon (DOC) have been found in surface waters. It has also become clear that land use has an important effect on DOC export. Causal factors controlling this temporal and spatial variation are not clear. Furthermore, efforts to model DOC export on a catchment scale are rare.

In this research, it was investigated whether variations in DOC concentration and quality in surface waters are mainly caused by hydrological processes, rather than by factors controlling the production of DOM. Furthermore, the importance of the different pathways (surface runoff, subsurface flow and groundwater flow) for the transport of DOM from the soil to surface water, is determined.

Six headwater catchments (100 - 400 ha) were selected in Belgium, representing three different types of land use, namely forest, grassland and arable land. At the outlet of each catchment, a flow-proportional sampler was installed. Samples of base flow and peak discharge are being collected since January 2010. Selected samples were analyzed for dissolved organic carbon and specific UV absorbance (SUVA). In addition to the flow-proportional samples collected at the outlet, samples of groundwater and subsurface water were collected on a regular base in three of the catchments. Elemental analysis was carried out using ICP-MS.

Overall, DOC concentrations were highest in forest catchments and lowest in grassland catchments. For all land use types, DOC concentrations were highest during peak discharge. This rise in DOC concentrations is associated with a change in DOC quality. During peak events, higher SUVA values were measured, indicating DOC with higher aromaticity (humic and fulvic fractions) reaches the outlet during periods of greater discharge. The rise in DOC concentrations and the high aromaticity of DOC during peak events can be explained by increasing contributions of surface and subsurface flow paths during periods of high discharge. Preferential flow during peak events allows highly aromatic DOC compounds to reach the catchment outlet.

Elemental analysis shows a significant difference in the geochemical composition of the river water if peak events are compared to base flow samples. These results are now being complemented by elemental analysis of the end-members, using the groundwater and soil water samples, which will allow an end-member-mixing-analysis (EMMA). This makes it possible to identify the contributing pathways for the transport of organic matter from the soil to the surface water during base and peak flow. Results of these analyses will be an important step towards a model describing DOC transport at the catchment scale.