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Lateral transport of phosphorus along forested hillslopes

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Details about the phosphorus (P)-cycle in temperate forests are still incomplete, though there are indications that the organic topsoil acts as an important source and sink for P. It can act as a sink for P in fallen litter and as a source since the decaying biomass replenishes the pool of inorganic, water soluble and thus plant available P. The aim of this study was to determine the magnitude of lateral mobilization, transport and retention of total P (persulfate digestion method) in the soil at various depths of a broadleaf forest during heavy rainstorm events. On three locations in Germany, 10 m long and over 3m deep trenches were constructed to collect lateral subsurface flow from three discrete depth-layers between the soil surface and a depth of three meters. Sampling is handled through an automated system which collects flow-proportional samples in high temporal resolution. Sampling took place from March to November 2015 including more than 20 rainfall runoff events. Simultaneously to the sampling, flow rate, conductivity and temperature of the interflow was measured as well as soil moisture, rainfall and discharge in the nearest downslope spring.
The results show consistently that P-concentrations in interflow samples are highest at the beginning of a rainfall-interflow-event, both for wet and dry initial conditions, and drop considerably over the course of the event until they stabilize. Secondly, P-concentration of interflow samples is by far highest in the organic topsoil, being up to one magnitude higher that in the mineral soil directly below and decreasing further with depth. This pattern applies despite the fact that there is very little temporal delay between the activation of interflow in the topsoil and deeper layers which indicates that at least some of the interflow in the topsoil ends up as interflow in deeper layers within a short time span. These results indicate that the organic topsoil contains a pool of P that is easily mobilized and transported by water within this layer, but also partly to deeper soil layers. The results also show that retention of P within the soil happens effectively and fast, even during interflow events with high flow rates.