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Transfer processes of sediments and particle bound phosphorous in loess catchments

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The transfer of sediments and particle bound substances such as nutrients and contaminants from the source areas to surface waters is a complex phenomenon. In process based soil erosion models the emission of sediments and associated substances is thus quantified by representing all relevant sub processes such as detachment, transport and deposition of sediment particles and aggregates along the flow path to the river. Due to selective transport and deposition processes, fine particle fractions are enriched during the transfer of the sediments to surface waters. In addition, nutrients and contaminants are preferentially bound to fine particle fractions because of their higher specific surface. The adequate representation of the interaction of particle size fractions during the transfer of sediments is thus of importance for predicting the particle bound nutrient and contaminant emissions of watersheds. On the other hand, the knowledge of particle bound substance concentrations can be used to analyze the interaction processes of particle size fractions during sediment transfer.
We used the process based erosion model CATFLOW-SED to test hypotheses on the size selective character of soil detachment and transport for loess soils. The model simulates water and erosion dynamics on the hillslope and catchment scale. The detachment rate of sediment particles from the soil matrix is quantified using an optimized approach for loess soils, based on the correlation of the attacking forces of rainfall and surface runoff to the erosion rate. The amount of detached soil particles depends on the parameter erosion resistance which is characterized by soil properties, land use and management practice. Sediment transport capacity is modelled for various grain size fractions using the equation of ENGELUND & HANSEN (1967). The deposition of particles depends on the sinking velocity rate of the grain size fractions and is thus a highly size selective process. However, it is not clear from experimental studies if the transport of particles is size selective, too.
We therefore used phosphorous concentrations of various grain size fractions from loess soils of the Weiherbach catchment in Southwest Germany as well as phosphorous concentrations in the sediment load of the catchment to analyze different model approaches to represent the interaction of grain size fractions during transport.