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Spatially distributed modeling of sediment and associated heavy metal transport on regional and catchment scale

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Achievements of new legislations, as EU-Water Framework Directive (EU-WFD), require great efforts in order to reduce the yields of sediment and sediment attached heavy metals of surface water bodies. In this regard planning authorities strongly need comparable assessments on regional scale, which enables predictions on the level of measures.

The study aims to identify the main sediment delivery areas in the German federal state of Saxony (18400 km^2) and to locate pass over points of sediment and associated heavy metals into surface waters. Applying the process based EROSION 3D simulation model spatially distributed (20 m grid cell) estimates of sediment and particle attached heavy metal inputs are realized on regional and catchment scale related to three land use scenarios and a 10years rainfall event.

Concerning these calculations it has to be considered, that this substances are predominantly attached to the fine-grained soil particles. The selective nature of soil erosion causes a preferentially transport of this fine particles while less contaminated larger particles remain on site. Consequently heavy metals are enriched in the eroded sediment compared to the origin soil. Hence it is essential that EROSION 3D provides the particle size distribution (clay, silt and sand) of transported sediments. Regarding heavy metal input calculations from sediment inputs, heavy metal contents of particle size classes has to be known. For this purpose particle size separates of erosion susceptible soils are analyzed. Comprehensive heavy metal contents of origin top soils are interpolated via kriging using available monitoring data.

The regional scaled simulations identify the Saxon loess belt as the main affected region of sediment inputs. Since particle attached heavy metal transport to surface waters is strongly related to sediment delivery, the streams of this region suffer from considerable inputs. Compared to empirical estimates, the results of this study suggest that heavy metal inputs in surface waters are much higher. These massive differences might be caused by neglecting high inputs during extreme events due to an inappropriate sampling regime. Available empirical data seem to reflect base loads of heavy metals rather than total loads.

Up to know the EROSION 3D based simulation of heavy metal transport into surface water bodies is successfully validated on catchment scale. The comprehensive assessment of heavy metal inputs can be used for the planning and implementation of an integrated catchment management full filling the aims of the EU-WFD.