How does slope form affect erosion in CATFLOW-SED?

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Erosion is a severe environmental problem in agro-ecosystems with highly erodible loess soils. It is controlled by various factors, e.g. rainfall intensity, initial wetness conditions, soil type, land use and tillage practice. Furthermore slope form and gradient have been shown to influence erosion amounts to a large extent. Within the last fifty years, various erosion models have been developed to describe the erosion process, estimate erosion amounts and identify erosion-prone areas. These models differ in terms of complexity, the processes which are considered, and the data required for model calibration and they can be categorised into empirical or statistical, conceptual, and physically-based models.

CATFLOW-SED is a process-based hydrology and erosion model that can operate on catchment and hillslope scales. Soil water dynamics are described by the Richards equation including effective approaches for preferential flow. Evapotranspiration is simulated using an approach based on the Penman-Monteith equation. The model simulates overland flow using the diffusion wave equation. Soil detachment is related to the attacking forces of rainfall and overland flow, and the erosion resistance of soil. Sediment transport capacity and sediment deposition are related to overland flow velocity using the equation of Engelund and Hansen and the sinking velocity of grain sizes respectively.

We performed a study to analyse the erosion process on different virtual hillslopes, with varying slope gradient and slope form, using the CATFLOW-SED model. We explored the role of landform on erosion and sedimentation, particularly we look for forms that either maximise or minimise erosion. Results indicate the importance to performing the process implementation within physically meaningful limits and choose appropriate model parameters respectively.