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Assessing lateral organic Carbon movement in small agricultural catchments

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The effects of lateral movement of organic Carbon (OC) by soil erosion through terrestrial into aquatic ecosystems on global biogeochemical cycles, and thus climate change, is subject to a controversial debate. A key issue for geomorphic research is the lack of spatial data and models to simulate the transfer of OC from hillslopes to waterways. Comparison of soil and rill sediment properties in the Spangerbach catchment in the Eifel region of Germany illustrates that erosion models have to capture the soil and sediment properties which determine resistance to erosion, transport and deposition of particles varying in size, density, shape and OC content. We argue that settling velocity of soil and sediment particles offers a direct physical connection between soil or sediment and its susceptibility to erosion and should thus be developed into an erodibility parameter. Texture, OC and nutrient content of varying classes of particles with similar settling velocity can be determined easily and thus added to settling velocity specific erosion models. Key contributions of Geomorphology to the integration of settling velocity as a particle specific erodibility parameter are (i) the development of relationships which relate flow hydraulics to the effects of particle density and shape to their resistance to entrainment, transport and deposition; (ii) the identification of a limited number of settling velocity classes that represent the full range of sediment properties relevant for transport, deposition and sediment properties such as OC; (iii) the development of parameters describing the changes of sediment settling velocities while transported through a catchment; (iv) the spatially distributed simulation of concentrated flow hydraulics across landscapes to model erosion and selective deposition; and (v) tracking changes of OC content in the soil profile by simulating a 3-dimensional spatial soil domain.