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Differential Effects of Water Erosion and Tillage Erosion on Carbon Dynamics on Arable Land

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Global agricultural soil erosion has been proved to be a carbon sink. Water erosion and tillage erosion are the two dominant forms of soil redistribution processes in agricultural catchments. However, there is still no research trying to evaluate whether they play different roles in perturbing the carbon dynamics of agricultural land. By calibrating a spatially distributed soil erosion model on a small agricultural catchment, the proportion of the deposits by water erosion and tillage erosion at different positions of the soil bank formed at the field border can be estimated: grain size analysis confirms that the relative contribution of tillage and water vary with landscape position. The results derived from the water erosion model are further processed with a model elucidating soil organic matter dynamics through the soil profile that is calibrated with detailed measured soil carbon profiles both on the slope and at the soil bank. Different decomposition rates for the carbon deposited by different erosion processes were derived from model simulations by matching observed and simulated profiles of total carbon as well as of delta 13C. Incubation of soil cores at both water erosion and tillage erosion dominated deposits was also conducted so that an attempt can be made to discriminate between the effects of burial and carbon quality on carbon decomposition rates. Different effects of water erosion and tillage erosion on the carbon dynamics in the catchment were assessed and possible mechanisms behind them are discussed using evidence from total carbon content, delta 13C and grain size profiles.