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Did tillage erosion play a role in millennial scale landscape development? - an evaluation in SE Spain using a landscape evolution model

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Landscape evolution models (LEMs) quantitatively simulate processes of sedimentation and erosion on millennial timescales. An important aspect of human impact on erosion is sediment redistribution due to agriculture, referred to herein as tillage erosion. In this study we aim to analyse the potential contribution of tillage erosion to landscape development using a LEM. The model is separately calibrated for i) water erosion processes only and ii) water plus tillage erosion processes. The model is applied to the ∼250 km2 Torrealvilla case study catchment, SE Spain. We were able to simulate alternating sequences of incision and aggradation, that are important on longer (millennial) timescales. Generally, model results show that tillage erosion adds to deposition in the lower floodplain area, but neither water erosion alone nor water plus tillage erosion together could exactly reproduce the observed amounts of erosion and sedimentation for the case study area. This implies that other processes, not included in the model, and / or input and model assumptions and uncertainties, play a role. In addition, scale effects are apparent: on hillslopes, tillage importantly contributes to erosion and fills local depressions. On the catchment scale, sediments from tillage erosion eventually reach the floodplain area. Here they contribute to aggradation, but to a lesser extent than on hillslopes, also depending on the connectivity within the catchment. This is the first time that tillage erosion is explicitly included in a landscape evolution model on a millennial timescale and large catchment scale.