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Improving Spatial Predictions of Soil Erosion: a Long-Term Perspective

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Soil erosion processes have been studied intensively throughout the last decades and rates have been measured at various scales. However, the relevance of this knowledge for the modelling of long-term landscape evolution remains unclear. In this study, we investigate if and to what extent estimates of long-term erosion rates are consistent with information obtained over much shorter time spans in the Belgian loess belt. We explore the possibility of calibrating a long-term topography-based erosion and deposition model using short-term data, focusing on the spatial sediment redistribution patterns as well as on the outlet sediment yields. In a first step, observed short-term, medium-term and long-term patterns are compared statistically, by classifying the study area into landscape element classes and comparing average erosion values per class. This analysis strongly suggests that the intensities on three temporal scales for each landscape element class are of the same order of magnitude. Secondly, the spatially distributed model WaTEM LT is calibrated based on the available short-term data by optimising average erosion values for the landscape element classes. The results of the model simulations are also consistent with data from similar areas found in literature. Finally, the calibrated model is used on a millennial time scale, and is validated using data based on soil truncation. The results show that the model is able to simulate landform evolution on a long time scale using information derived from short-term erosion and deposition data. This study shows that, at least for the Belgian loess area, data obtained on erosion and deposition over various temporal and spatial scales have the same orders of magnitude, thereby indicating that measurements of current rates of processes can be highly relevant for interpreting long-term landscape evolution. Furthermore, this outcome opens a range of new possibilities in the parameterisation of longer term soil erosion models.