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Confronting sediment budgets for different time periods in the Holocene with contemporary erosion process understanding

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Soil erosion and sediment deposition are important geomorphic processes in the central European loess belt. Several studies have shown that important changes in the rates of soil erosion and sediment deposition occurred during the Holocene. Sediment budget approaches are ideal tools to understand such complex system behavior during the Holocene. Within this study a temporal differentiated Holocene sediment budget based on field data was constructed for the Belgian Dijle catchment (870 km^2), and compared with a soil erosion model that was applied for the same time periods.

Hand auger data from 6 locations were extrapolated to the entire catchment using different geomorphic units in order to calculate Holocene slope erosion and deposition amounts. Alluvial deposition was calculated using 26 hand auger cross valley profiles, spread over the catchment. A distinction was made between the main valley and the tributaries. In total 73 radiocarbon dates and 12 OSL dates from 3 colluvial and 8 alluvial sediment archives were used to split this sediment budget into three different time frames: early Holocene until 500 BC, 500 BC – 1000 AD and 1000 AD – present.

The spatially distributed soil erosion and sediment deposition model WATEM/SEDEM was used to asses the soil erosion intensities for various historic periods for which land use was estimated based on population density and arable area per capita estimates: a pristine forest cover representing the pre-Neolithic period, Neolithic period, Roman times, Middle Ages (1200 AD-1300 AD) and pre-industrial times (1600 AD-1700 AD). Model outcomes were confronted with the sediment budget that was constructed by the field-based approach.

The resulting sediment budget shows clearly an increase of sediment deposition in the late Holocene, first starting in the colluvial valleys and later on prograding towards the larger valleys. Although climate may have been a trigger in some cases, it is clear that land use changes are the main explaining factor. Model results are generally in agreement with this sediment budget, further more stressing the importance of land use changes. These results indicate that contemporary process understanding, on which the model is based, can be used for long term sediment budget studies.