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Towards realistic Holocene land cover scenarios: integration of archaeological, palynological and geomorphological records and comparison to global land cover scenarios.

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Accurate and spatially explicit landscape reconstructions for distinct time periods in human history are essential for the quantification of the effect of anthropogenic land cover changes on, e.g., global biogeochemical cycles, ecology, and geomorphic processes, and to improve our understanding of interaction between humans and the environment in general. A long-term perspective covering Mid and Late Holocene land use changes is recommended in this context, as it provides a baseline to evaluate human impact in more recent periods. Previous efforts to assess the evolution and intensity of agricultural land cover in past centuries or millennia have predominantly focused on palynological records. An increasing number of quantitative techniques has been developed during the last two decades to transfer palynological data to land cover estimates. However, these techniques have to deal with equifinality issues and, furthermore, do not sufficiently allow to reconstruct spatial patterns of past land cover. On the other hand, several continental and global databases of historical anthropogenic land cover changes based on estimates of global population and the required agricultural land per capita have been developed in the past decennium. However, at such long temporal and spatial scales, reconstruction of past anthropogenic land cover intensities and spatial patterns necessarily involves many uncertainties and assumptions as well. Here, we present a novel approach that combines archaeological, palynological and geomorphological data for the Dijle catchment in the central Belgium Loess Belt in order to arrive at more realistic Holocene land cover histories. Multiple land cover scenarios (> 60.000) are constructed using probabilistic rules and used as input into a sediment delivery model (WaTEM/SEDEM). Model outcomes are confronted with a detailed geomorphic dataset on Holocene sediment fluxes and with REVEALS based estimates of vegetation cover using palynological data from six alluvial sites. This comparison drastically reduces the number of realistic land cover scenarios for various cultural periods. REVEALS based land cover histories provide more accurate estimates of Holocene sediment fluxes compared to global land cover scenarios (KK10 and HYDE 3.1). Both global land cover scenarios produce erroneous results when applied at their original coarse scale resolution. However, spatially allocating KK10 land cover data to a finer spatial resolution increases its performance, whereas this is not the case for HYDE 3.1. Results suggest that KK10 also offers a more realistic history of human impact than HYDE 3.1 although it overestimates human impact in the Belgian Loess Belt prior to the Roman Age, whereas it underestimates human impact from the Medieval Period onwards.