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Modelling past hydrology of an interfluve area in the Campine region (NE Belgium)

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This study aims at hydrological model verification of a small lowland interfluve area (18.6 km^2) in NE Belgium, for conditions that are different than today. We compare the current state with five reference periods in the past (AD 1500, 1770, 1854, 1909 and 1961) representing important stages of landscape evolution in the study area. Historical information and proxy data are used to derive conceptual model features and boundary conditions specific to each period: topography, surface water geometry (canal, drains and lakes), land use, soils, vegetation and climate. The influence of landscape evolution on the hydrological cycle is assessed using numerical simulations of a coupled unsaturated zone – groundwater model (HYDRUS-MODFLOW). The induced hydrological changes are assessed in terms of groundwater level, recharge, evapotranspiration, and surface water discharge. HYDRUS-MODFLOW coupling allows including important processes such as the groundwater contribution to evapotranspiration.

Major land use change occurred between AD 1854 and 1909, with about 41% of the study area being converted from heath to coniferous forest, together with the development of a drainage network. Results show that this led to a significant decrease of groundwater recharge and lowering of the groundwater table.

A limitation of the study lies in the comparison of simulated past hydrology with appropriate palaeo-records. Examples are given as how some indicators (groundwater head, swamp zones) can be used to tend to model validation.

Quantifying the relative impact of land use and climate changes requires running sensitivity simulations where the models using alternative land use are run with the climate forcing of other periods. A few examples of such sensitivity runs are presented in order to compare the influence of land use and climate change on the study area hydrology.