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Modeling of technical soil-erosion control measures and its impact on soil erosion off-site effects within urban areas

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The paper presents results of surface runoff, soil erosion and sediment transport modeling using Erosion 3D software – physically based mathematical simulation model, event oriented, fully distributed. Various methods to simulate technical soil-erosion conservation measures were tested, using alternative digital elevation models of different precision and resolution. Ditches and baulks were simulated by three different approaches, (i) by change of the land-cover parameters to increase infiltration and decrease flow velocity, (ii) by change of the land-cover parameters to completely infiltrate the surface runoff and (iii) by adjusting the height of the digital elevation model by "burning in" the channels of the ditches. Results show advantages and disadvantages of each approach and conclude suitable methods for combinations of particular digital elevation model and purpose of the simulations.
Further on a set of simulations was carried out to model situations before and after technical soil-erosion conservation measures application within a small catchment of 4 km2. These simulations were focused on quantitative and qualitative assessment of technical soil-erosion control measures impact on soil erosion off-site effects within urban areas located downstream of intensively used agricultural fields. The scenarios were built upon a raster digital elevation model with spatial resolution of 3 meters derived from LiDAR 5G vector point elevation data. Use of this high-resolution elevation model allowed simulating the technical soil-erosion control measures by direct terrain elevation adjustment. Also the structures within the settlements were emulated by direct change in the elevation of the terrain model. The buildings were lifted up to simulate complicated flow behavior of the surface runoff within urban areas, using approach of Arévalo (Arévalo, 2011) but focusing on the use of commonly available data without extensive detailed editing.
Application of the technical soil-erosion control measures induced strong change in overall amount of eroded/deposited material as well as spatial erosion/deposition patterns within the settlement areas. Validation of modeled scenarios and effects on measured data was not possible as no real runoff event was recorded in the target area so the conclusions were made by comparing the different modeled scenarios. Advantages and disadvantages of used approach to simulate technical soil-erosion conservation measures are evaluated and discussed as well as the impact of use of high-resolution elevation data on the intensity and spatial distribution of soil erosion and deposition. Model approved ability to show detailed distribution of damages over target urban area, which is very sensitive for off-site effects of surface runoff, soil erosion and sediment transport and also high sensitivity to input data, especially to DEM, which affects surface runoff pattern and therefore intensity of harmful effects.

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