Deriving and testing parameter values for a parsimonious soil erosion model

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Abstract

Every application of soil erosion models brings the need of proper parametrization, i.e., finding physically or conceptually plausible parameter values that allow a model to reproduce measured values. No universal approach for model parametrization, calibration and validation exists, as it depends on the model, spatial and temporal resolution and the nature of the datasets used. We explored some existing options for parametrization, calibration and validation for erosion modelling exemplary with a specific dataset and modelling approach. A modified version of the Morgan-Morgan-Finney (MMF) model was selected, representing a balanced position between physically-based and empirical modelling approaches. The resulting calculator for soil erosion (CASE) model works in a spatially distributed way on the timescale of individual rainfall events. A dataset of 142 high-intensity rainfall experiments in Central Europe (AT, HU, IT, CZ), covering various slopes, soil types and experimental designs was used for calibration and validation with a modified Monte-Carlo approach. Subsequently, model parameter values were compared to parameter values obtained by alternative methods (measurements, pedotransfer functions, literature data). The model reproduced runoff and soil loss of the dataset in the validation setting with R^2_{adj} of 0.89 and 0.76, respectively. Satisfactory agreement for the water phase was found, with calibrated saturated hydraulic conductivity (k_{sat}) values falling within the interquartile range of k_{sat} predicted with 14 different PTFs, or being within one order of magnitude. The chosen approach also well reflected specific experimental setups contained in the dataset dealing with the effects of consecutive rainfall and different soil water conditions. For the sediment phase of the tested model agreement between calibrated cohesion, literature values and field measurements were only partially in line. For future applications of similar model applications or datasets, the obtained parameter combinations as well as the explored methods for deriving them may provide guidance.

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