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Comparison of runoff and soil loss generated on two plot sizes during rainfall simulation experiments

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Water erosion is a natural process of soil surface disturbance caused by rainfall and surface runoff and consequent transport of sediment and nutrients. Synthetic rainfall-runoff and erosion events and mathematical models are still actual and useful methods for analysing processes involved in surface runoff formation. Simulators with watered area of 1 m2 are often used due to the technical, financial and human resources limitations. Disadvantage of such small-scale simulators is that concentrated runoff seldom developes there which makes observations difficult to upscale. We present a set of experiments which were focused on the effect of plot size on observed surface runoff, soil loss and particle size distribution of suspended soils and on formation of preferential pathways.
The contribution presents the results of two years of measuring with the rainfall simulator. Presented experiments were focused especially on the comparison of runoff process dynamics, total runoff volume and soil loss from two plots of the different size. Rainfall simulator which was designed and is operated at CTU in Prague was used for the experiments (EGU2015-11025). Raindrops are produced by four Fulljet nozzles (40-WSQ) which allow to spray maximum area of 2 x 9.5 m (Christiansen's index of uniformity is 80 % on 2 x 8 m plot). The pairs of the experiments were performed simultaneously on the same location under the same rain characteristics (intensity and duration). Two experimental field plots with different dimensions (2x8 m and 1x1 m) had the same surface conditions (cultivated fallow or vegetation). The surface runoff parameters and the suspended solids concentration in runoff from the two plots were measured in the same intervals. The water outflow and the sediment yield comparison were used for the determination of the relationship between the plot size, induced erosion and runoff characteristics. The experiments were described by specific runoff discharge (expressed in liters per square meter) and suspended solids concentration which allows two plots with different dimensions comparison. Our results show influence of the field plot length and a clear increase in the soil loss with increasing plot length. The results suggest that the specific sediment concentration (related to one meter of the plot length) measured at the large plot gauge is about twice the concentration generated by the small plot. A sample for grain size estimation was taken during experiments in last year. The information was used for calculation and comparison of the dragging forces on both plots, the particle size distribution of the eroded particles was also compared to the topsoil texture.
The experiments were analysed also with the aim to validate the surface runoff parameters in the mathematical model SMODERP. The input parameters for validation were based on measured: rainfall intensity, time of surface runoff initiation, infiltration and surface runoff discharge, mean velocity and velocity in runoff preferential paths.

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