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Spatial and temporal variations of ponded infiltration in a grid of permanent infiltration rings

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The soil at Liz experimental site (Volynka headwater catchment, Sumava Mountains, southern Bohemia) has been subject to a long term research on the soil infiltration properties since 2003. For this purpose, 18 permanent infiltration rings were installed at a gently sloped grass-covered experimental plot (300 sq.m). Using this set-up, the single-ring ponded infiltration experiments have been conducted annually. Since 2005, a procedure of repeating the same ponded infiltration experiments in two successive days has been implemented.
For the soil type of the study area (sandy loam developed upon gneiss bedrock), a large spatial variability of soil hydraulic properties had been reported before. The focus of the present study has been primarily the temporal variability of the soil infiltration properties. Results of a supplementary dye-tracer experiment conducted in 2005 demonstrate that in the soil studied the infiltration process is strongly dominated by preferential flow.
As expected, infiltration rates varied considerably among the infiltration ring. With regard to the impact of the initial soil moisture conditions, general decrease of the infiltration rates observed on two subsequent days was detected. Surprisingly, the spatial variations between separate measuring points were vastly overridden by a huge overall increase of the infiltration rates observed throughout the years.
The observed variability of the experimental data was further examined in numerical simulations of hypothetical scenarios reflecting possible variations of soil profile and experimental set-up. Axisymmetric 3D simulations were performed using S2D code.
The dual-continuum model was able to describe part of the variability of infiltration curves associated with soil structure heterogeneity. None of the tested factors could explain the wide range of infiltration rate variations observed. Nevertheless, better agreement between simulated and observed infiltration characteristics could be achieved by combining several of these factors. Specifically, combination of increased hydraulic conductivity of the surface organic layer with large sink hole and significant volume of preferential pathways was needed to simulate extreme infiltration rates observed in recent years.