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How to derive Horton infiltration parameters from rainfall simulation data

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The sealing of the soil surface is an important process during heavy rainfall which should be taken into account for rainfall-runoff modelling, as it reduces infiltration rates and hence pro-motes surface runoff. However, this requires adequate model parameters from experimental data.

The most widely used method to assess infiltration rates and hence infiltration parameters for modelling approaches is the use of simulated rainfall plot experiments. In this study we used 300 rainfall simulations covering a great variety of soils (e.g. 5-85% silt), landuses (e.g. 0-80% cover) and rain conditions (e.g. rain intensities between 30-100 mm h-1). However, to derive infiltration rates and model parameters for Hortonian-type equations require several manipulations of the measured runoff rates during the experiments: Firstly, one has to account for the surface detention storage (SP). Secondly, one needs to apply a curve fitting procedure to determine the Horto-nian model parameters, which are initial infiltration rate (fo), decay constant (k) and end infiltration rate (fe).

We developed a method to account for Sp by the use of the relation between ponding time (tP) and the first occurrence of runoff, termed time to runoff (tR). This, however, is only possible if tP was determined during the simulation.

Regarding the curve fitting, many standard procedures e.g. simplex or conjugate-gradient algorithms were able to fit the data but the fitting parameters were inconsistent and often depended on the settings of the control parameters. This was due to the interrelation of fo and k, which thus could not be interpreted. This problem could be overcome by deriving the Horton infiltration parameters from the data since tP, which then makes it necessary to predict tP independently. Hence is of twofold importance for the determination of Horton parameters from rainfall simulations but it is rarely measured and reported.