Geophysical Research Abstracts,
Vol. 11, EGU2009-4496, 2009
EGU General Assembly 2009

Experimental rainfall-runoff data: the concept of infiltration capacity needs re-thinking

C. Langhans (1), G. Govers (1), J. Diels (1), A. Leys (2), W. Clymans (1), A. VandenPutte (1), and J. Valckx (1)

(1) Department of Earth and Environmental Sciences, K.U.Leuven, 3001 Heverlee, Belgium (christoph.langhans@ees.kuleuven.be), (2) Policy Division, Department of Agriculture and Fisheries, Flemish Government, Ellipsgebouw, 7th floor, Koning Albert II-Laan 35, bus 40, 1030 Brussels, Belgium

Runoff generation by infiltration excess at steady state is usually modelled with a single, constant final infiltration capacity and it represents the averaged effective hydraulic conductivity (Ke), which is assumed to be independent of rainfall intensity. Experimental data and advances in the conceptualization of the infiltration process, however, suggest that we need to replace the idea of an invariant Ke with a Ke that is fundamentally dependent on rainfall intensity. For the purpose of studying the relationship between rainfall intensity and infiltration, we developed a drop infiltrometer that is able to produce a wide range of drop intensities on a meaningful scale. Infiltration experiments were conducted on a winter wheat field in the Belgian Loess Belt and various surface and soil properties were measured. Furthermore, photos were taken of the soil surface during the infiltration experiments for the determination of the inundated surface fraction (Ai). Final infiltration rate vs. rainfall intensity could be modelled well with an exponential function, where infiltration increases with rainfall intensity. Within the range of measured intensities, however, a linear model could be fitted equally well to the data. After a transformation of infiltration and rainfall intensity data to its natural logarithm, error terms were normally distributed and hence, the data could be used in a regression analysis. Final infiltration rate was predicted successfully with rainfall intensity (Adj. R2: 0.88) on the one hand and Ai (Adj. R2: 0.74) on the other. Both relationships include soil and surface properties, notably macroporosity, residue cover and some roughness indices. Regression analysis shows Ai to be dependent on the natural logarithm of rainfall intensity together with the same properties mentioned above (Adj. R2: 0.84).

Our results show that, on crusted soil surfaces, the effective hydraulic conductivity is increasing with rainfall intensity, and that the notion of a constant infiltration capacity does not apply. This has important implications, both for surface runoff and erosion modelling. We propose that Ke in physically based infiltration models should reflect heterogeneity by being dependent on functions that account for preferential flow and different seal hydraulic conductivities in dependence of inundation. This approach holds more potential than an averaged Ke to deal with nonlinearity and scale effects in runoff generation.