

Rainfall simulations and double ring infiltration measurements – do the results correlate?



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Background

Runoff behaviour of soil-vegetation-complexes as well as the resulting hazard potential are significantly dominated by their infiltration characteristics. Thus the relation of surface runoff and infiltration and therewith also the runoff coefficient are in the focus of numerous hydrological soil investigations. For this purpose various field methods have been developed during the last decades, among them especially artificial rainfall simulations proved their value.

Investigating runoff behaviour of soil-vegetation-complexes by means of rainfall simulations is very cost-intensive and time-consuming. Additionally their application is strongly limited by water availability, especially in the headwaters of the catchment. For this reason we examine if statistical relationships exist that can characterize the outcomes of double ring infiltrometer measurements - which are comparatively easy to realize - and rainfall simulations.

Methods

Information on the hydrological reaction of 10 test slopes (hay meadows in the district Innsbruck Land, Tyrol, Austria) was gained by

- one artificial rainfall simulation each with an intensity of 100 mm/h (duration one hour, plot size 80 m²),
- several double ring infiltrometer measurements (diameter of the inner ring = 18 cm): three to four measurements simultaneously to the rainfall simulation slightly outside of the irrigated plot and two measurements on the irrigated plot directly subsequent to the rainfall simulation (total 63 infiltration experiments on the 10 plots),
- supplementary soil physical analyses.

The resulting dataset is analysed with empirical and statistical methods.



Fig.1: Rainfall simulation on an irrigation plot of 80 m²



Fig.2: Double ring infiltrometer

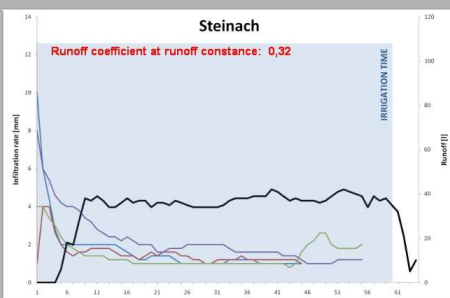


Fig.3: Inf. rate and surface runoff correspond

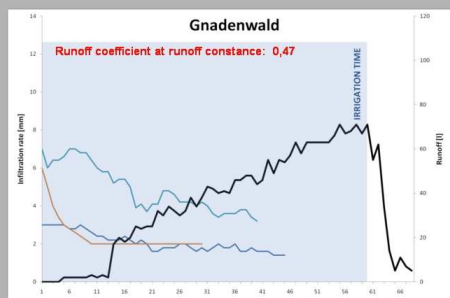


Fig.4: Inf. rate and surface runoff are diverse

First results

- Four plots developed a constant runoff coefficient during the rainfall simulation. Their double ring infiltration rates corresponded quite well with the rainfall simulation results (Fig.3).
- Four plots showed a nearly continuous rise of the runoff coefficient which may be explained by the transition from Hortonian overland flow to saturated overland flow (Kirnbauer et al. 2009: 29). Their double ring infiltration rates were very diverse and did not yield a correlation to the runoff coefficient gained from the sprinkling experiments (Fig.4).
- Two plots revealed no surface runoff during the rainfall simulation. While in first plot the measured high infiltration rates in the double ring infiltrometer coincided with the results of the rainfall simulation, this could not be stated for the second one.

Discussion and outlook

According to the first results the existence of relationships between runoff coefficients measured during rainfall simulations and double ring infiltration rates depends on the runoff process characteristics of the test plots. Further insights are expected from the ongoing detailed statistical analyses and the intended recalculation of the experiments with a hydrological slope model.