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Simulation of torrential rain as a means for assessment of surface runoff coefficients and calculation of recurrent design events in alpine catchments

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Simulation of heavy rain is an established method for studying infiltration characteristics, runoff and erosion behaviour in alpine catchments. Accordingly for characterization and differentiation of various runoff producing areas in alpine catchments transportable spray irrigation installations for large plots have been developed at the BFW, Department of Natural Hazards and Alpine Timberline, in Innsbruck, Austria. One installation has been designed for assessment of surface runoff coefficients under convective torrential rain with applicable precipitation intensities between 30 and 120 mm*h^{-1} and a plot size between 50 and 100 m^2. The second device is used for simulation of persistent rain events (rain intensity about 10 mm*h^{-1}, plot size: 400-1200 m^2). Very reasonable results have been achieved during the comparison with spray irrigations from other institutions (e.g. Bavarian Environmental Agency in Munich) in the field.

Rain simulations at BFW are mostly combined with comprehensive additional investigations on land-use, vegetation cover, soil physical characteristics, soil humidity, hydrogeology and other features of the test-sites. This allows proper interpretation of the achieved runoff data. At the moment results from more than 280 rain simulations are available from about 25 catchments / regions of the Eastern Alps at the BFW.

Results show that the surface runoff coefficient, when runoff is constant at the test site (ψ_{const}) increases only slightly between rain intensities from 30 to 120 mm*h^{-1} (increment is 6%). Therefore ψ_{const} shall be used for assessment of runoff behaviour of runoff contributing areas, because it is less dependent form system conditions than ψ_{tot}.

BFW-data have been consolidated with results of the LfU (Bavarian Environmental Agency in Munich) in a data base and formed the basis for the development of a simple code of practice for assessment of surface runoff coefficients in torrential rain. The manual is freely available under: http://bfw.ac.at/rz/bfwcms.web?dok=4342 (in German language).

The runoff contributing areas delineated by use of the manual in the field can be compiled in digital surface runoff coefficient maps and surface roughness maps. These maps in Austria form the basis for calculation of recurrent design events by use of precipitation/runoff models (P/R-models) like ZEMOKOST (optimized runtime method after Zeller = ZEller MOdified by KOhl and STepanek) or HEC-HMS. The result is substantial information on runoff disposition in each sub-catchment and hydrographs showing peak runoff and runoff freight.

The code of practice for assessment of surface runoff coefficients has become the standard procedure in Austria to derive input parameters for P/R-models in practice. Recent investigations done at the Institute of Geography at the University of Berne show that the code of practice is suitable for application in catchments at the northern edge of the Swiss Alps too.