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Automatic evaluation of dominant runoff processes for catchments with low resolution soil data

M. Margreth (1,2), F. Naef

(1,2) Institut for Environmental Engineering, ETH Zurich, Switzerland
(margreth@ifu.baug.ethz.ch / phone: +41 44 6333579)

The reaction of a catchment on rainfall depends on the distribution of the dominant runoff processes (DRP) like Hortonian Overland Flow (HOF), Saturated Overland Flow (SOF), Sub-surface Flow (SSF) or Deep Percolation (DP). A method was developed to determine the distribution of DRP automatically in a GIS using geological, topographical, land use information and information about soil formation. This automatic approach was applied successfully in catchments in the Swiss Plateau and in the Alps where high resolution information of soils and geology were available.

Such detailed information is often not available. However, as soil formation in alpine catchments depends strongly on topography and geology, high resolution soil information can be derived with some effort. A body of rules was developed to estimate soil depth, grain size distribution and soil water regime from low resolution soil maps, DEM, geological and land use information. The method was applied successfully for the alpine catchments of Allenbach (26 km^2) and Lütschine (379 km^2), both lying in Kanton Bern. The Allenbach reacts fast and intense to thunderstorms, whereas a neighbouring catchment with similar size and topography reacts delayed, due to large storage volumes in highly permeable rockfall deposits, morains or karst formations. It is interesting to note, that even steep alpine catchments can react delayed.

In the Swiss Plateau, soil formation is more complex and depends on different factors, which are not easily recognisable. To develop a body of rules estimating the distribution of soil type, soil depth, grain size distribution and the soil water balance, the soil forming factors had to be identified. Therefore, a mixed approach between analysis of spatial and point data was applied in areas, where high resolution geological and soil maps and soil profile samples are available. To identify rules for the spatial distribution of soil types and soil water balance, different catenas and the arrangement of groundwater influenced soils and soils with poor drainage were analysed depending on landscape type, topography, underlying bedrock and the connection to the river network. Soil profile samples were used to search correlations between soil depth, grain size distribution, relief and geology. Based on this knowledge, together with a high resolution laser scanned DEM, the distribution of the required hydrological soil parameters could be estimated successfully.

This approach allows to apply process based rainfall runoff models with high temporal and spatial resolution, in gauged and ungauged catchments, even if only low resolution soil information is available.