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Derivation of dominant runoff processes in an alpine catchment using vegetation and relief data

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The response of small catchments (< 20 km^2) to intense precipitation is strongly controlled by both size and connection to the channel network of subareas producing overland flow and/or fast subsurface flow. Maps of dominant runoff processes are powerful tools to identify those subareas of high relevance for flood formation. Decision schemes for the identification of dominant runoff processes are frequently based on detailed information on soils, vegetation and landuse (e.g. Peschke et al., IHI-Schriften 10, 1999; Scherrer & Naef, Hydrol.Process. 17, 2003). However, high-resolution soil data are hardly available in alpine areas since soil mapping of complex mountain environments is very time-consuming. As morphological characteristics strongly control both pedogenesis and hydrological processes in areas with high relief energy, the question arises to what extent soil information can be substituted by relief data.

The application of relief data for the explanation of hydrological processes was investigated in a small alpine catchment (Brixenbachtal, Tyrol, Austria, 9 km^2). Based on detailed soil and vegetation mapping as well as infiltration experiments, a map showing the dominant runoff process for each subarea was generated. In a second step the data mining programme CART (Classification and Regression Trees) was used to investigate the relationship between the dominant runoff process and geomorphometric characteristics for each pixel. The results are quite encouraging: With a misclassification rate of less than 15%, the dominant runoff process could be delineated from vegetation information (which can be derived from orthophotos and verified in the field) and relief information. Four geomorphometric parameters proved to be the most powerful predictors within the classification tree: (i) ln(tan slope/flowlength) (Schmidt et al., Z.Geomorph.N.F. Suppl.-Bd. 112, 1998), (ii) the downslope distant gradient (Hjerdt et al., WRR 40, 2004), (iii) the topographic wetness index or its derivate, the saga wetness index (Böhner et al., Europ.Soil Bureau, Research Report No. 7, 2002), respectively, (iv) the length-slope-factor (Moore et al., Hydrol.Process. 5, 1991).