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With high resolution DEM to enhanced maps of Dominant Runoff Processes (DRP)

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The reaction of a river on intense rainfall depends on the distribution of the dominant runoff processes (DRP) Hortonian Overland Flow (HOF), Saturated Overland Flow (SOF), Sub-surface Flow (SSF) or Deep Percolation (DP) within its catchment area. A decision scheme to determine the DRP was implemented in a GIS, using high resolution data of soils, geology, land use and topography. With the scheme, a DRP map was derived for the Kanton of Zurich with an area of 1730 km2, which lies in the Swiss Plateau and covers a wide range of topography, geology and flood producing precipitation regimes.
Detailed soil maps are essential for the derivation of high resolution dominant runoff processes maps because they contain information about the soil infiltration and the storage capacity. In the Kanton of Zurich, only a small part of the forested areas is covered by detailed soil maps. Information like soil depth and soil water regime had to be derived from the forest vegetation map (1:5'000). In this map, species of plants, grouped to forest communities, are delineated, depending on their preferred site conditions. Besides geology, topography and climate, also soil water regime and soil depth influence the occurence of plant species. However, a comparison between the soil water regime, indicated by detailed soil maps and the forest vegetation map shows that not all forest communities are selective for the soil water regime and soil depth. Thus, only some forest communities can be used, to derive the DRP.

For the other forest communities, an automatic method had to be developed to derive soil water regime and soil depth, based on a high resolution geological map and a laser scanned DEM. With the high resolution topographic information, small creeks, drainage ditches and erosion ditches could be identified. These areas indicate where a fast runoff reaction during heavy rainfalls can be expected. Creeks and drainage ditches suggest that soils do not drain properly and are saturated. Erosion ditches indicate the generation of quick SOF, caused by limited soil depth. In 20 catchments of different sizes, with different topography and different geology, the automatically derived DRP maps were compared with manually developed ones. In 80% to 99%, the automatically derived DRP areas match the manually developed ones or differ by 1 step in process intensity. As this method allows the derivation of enhanced DRP maps in high resolution, the DRP maps can also be used to forecast the runoff reaction of small catchments.