K O L L O Q U I U M

Zentrum für Wasserforschung und Institut für Hydrologie

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Dominant Runoff Generation Processes in Hydrological Modeling

Large scale landuse changes have been making the news throughout the world. However, the assessment of landuse change impacts on the hydrological cycle is still a challenging task. Complex hydrological models cannot be applied successfully to watersheds without detailed climate, vegetation, soil, and runoff data. Simple models do often not provide sufficient support for spatially distributed landuse management decisions. Therefore, we developed parsimonious, process-based, spatially-distributed hydrologic models to assess effects of landuse changes on runoff in ungauged basins. The introduced models were based upon the assumption that storm runoff is predominantly generated on certain areas of a watershed. The most commonly used method to predict the runoff generation areas is the concept of dominant runoff generation processes (DRP).

In particular, forecasts of saturation overland flow generating areas have been controversial in previous research. Therefore, we evaluated traditional and new soil saturation prediction concepts with field data in the first part of our study. Second, DRP model structures were developed. Established DRP area delineation was extended with dynamic process and connectivity modules. The latter were found to improve model fit and parameter feasibility, particularly in process-based DRP models. Temporal connectivity distributions demonstrated that Hortonian overland flow was more affected by connectivity than storm subsurface flow. Third, the DRP models were used to predict stream flow volume, dynamics, and effects of landuse changes on peak flow. DRP-based snowmelt and peak flow predictions agreed well with observed data. The model was used to predict effects of the mountain pine beetle infestation in British Columbia on peak flow in 290 watersheds. Peak flow increases up to 70% were forecasted, and a strong relationship between peak flow increase and landuse change affected area proportion of a watershed was found.

Klemens Rosin studied civil and environmental engineering at ETH Zurich. In spring 2010, he submitted his PhD thesis in forest hydrology at the University of British Columbia (Vancouver), and received his education diploma in environmental science from ETH Zurich (‘Gymnasiumslehrer’; physics, biology, chemistry).