Geophysical Research Abstracts,
Vol. 11, EGU2009-4369, 2009
EGU General Assembly 2009

Hydrology of a vine-growing landscape: Modeling hydrologic flows at the hill slope and catchment scale

T. Pohlert, S. Leimer, Y. Oelmann, and W. Wilcke
Soil Geography/Soil Science, Geographic Institute, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The implementation of spatially distributed catchment characteristics, such as saturated hydraulic conductivity ($K*$) and patterns of land-cover dynamics into process based models is an essential task for successful modeling of the hydrologic catchment behavior. In this study we present a methodology for model-setup (i.e. discretization and parameterization) with field data and readily-available data, and the performance of the distributed CATFLOW model.

The distributed CATFLOW model aims to continuously simulate hydrologic flows (i.e. evapotranspiration, interception, infiltration and surface run-off, subsurface matrix-flow, subsurface macro pore flow, return flow) at individual hill slopes that drain into the channel for variable time steps (e.g. minutes to hours).

The case study is conducted in a small catchment (10 km^2) located in the Middle Rhine Valley, Germany. The catchment is characterized by steep slopes ($\alpha < 43°$) and highly conductive soils (mean $K*$ = 12.8 cm/h, $n = 51$) with high rock contents (mean: 31 %, $n = 47$). The physical characteristics of the soils are significantly influenced by agricultural management, such as deep ploughing in vineyards, the age of fallow land or the absence of soil management in forested areas. For the model-setup, $K*$ ($n = 51$) was measured in the field with an Amoozemeter, and both, land-cover and hill-slope information were recorded for each site. Furthermore, soil texture of representative soil samples ($n = 11$) was analyzed for a consequent estimation of parameters for the $K(\theta)$ function using the ROSETTA software package. Saturated conductivity ($K*$) was regionalized using a GIS with the combined information of a land-cover and slope-class map, because the combination of these landscape properties was a significant predictor for $K*$ according to a one-way ANOVA, $F(12, 38) = 4.12, p < 0.01$. The combination of land cover and slope class ($R^2 = 0.565, k = 13, n = 51$) improved the accuracy of the regionalization of $K*$ as opposed to using only the land-cover information ($R^2 = 0.434, k = 7, n = 51$). Vegetation dynamics (e.g. crop rotation, LAI) were regionalized using the land-cover map and literature data. Hourly meteorologic records of three nearby stations for the period 2004-2008 were quality-checked and used for model input. In the paper we will further present the model performance of CATFLOW at the catchment outlet as well as simulated moisture dynamics for selected hill slopes.