Geophysical Research Abstracts, Vol. 7, 03299, 2005
SRef-ID: 1607-7962/gra/EGU05-A-03299

Parameter evaluation for rainfall runoff models using runoff process maps

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Runoff during flood events is formed either by Hortonian overland flow, saturated overland flow, subsurface stormflow or deep percolation. These processes differ in the amount of water that can infiltrate and be stored in the soil and in the way the soil is drained. It is therefore advisable to model each process in a different module. It is shown how this distinction allows the determination of the model parameters describing infiltration, the filling and the storage capacity of the soil from soil properties only and not by calibration. The contribution of each process to total runoff depends on the spatial distribution of the runoff processes in a catchment; hence these parameters can be derived from maps of dominant runoff processes.

Presented are results from a 2 km^2 experimental catchment where detailed field evaluations have been made. The simulation results not only agreed reasonably well with the measured runoff, they also reproduced the soil water level measurements on plots with different processes and were confirmed by results from tracer experiments. However, some problems occurred in the simulation of the falling limb of the flood hydrographs due to problems in reproducing the rapid drainage of the soil. The available data show a complex interaction between preferential and matrix flows, which is not yet fully understood.

The model was then applied to two neighboring catchments with areas of 2 km^2 and 46 km^2, which showed different reactions to intense precipitation events. Taking into account the different spatial distribution of runoff processes observed in these catchments, these different reactions could be reproduced.

The combination of runoff process maps with models treating these processes separately offers advantages, like reducing the dependency on calibration and gaining more insight into runoff formation. In addition, the work presented here demonstrates

how the effort to apply such models can be significantly reduced.