HYDROLOGICAL ASSESSMENT OF TORRENTIAL CATCHMENTS – A TOOL FOR PRACTITIONERS

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Floods from small torrential catchments cause a large amount of damage every year. Despite this fact there is only a small number of gauged mountain torrents with a long period of measurements allowing the estimation of peak flows with statistical methods. Therefore tools for the hydrological assessment of ungauged torrential catchments are crucial.

AIMS AND METHODS

In Switzerland the HAKESCH approach is frequently used to estimate peak flows of small ungauged catchments (<10 km^2). The software package uses five models to assess peak flows (HQ_{20}, HQ_{100}) of small watersheds. HAKESCH is the starting point of the present study which on one hand aims to improve this approach. On the other hand the accuracy of the model calculations should be enhanced by additional information. All in all, the following steps are used to assess the hydrological hazard of small torrential catchments: A) determination of the disposition for flood by different procedures, B) estimation of peak flows of different return periods and C) provision of a qualitative hydrograph (see Fig. 1). These three steps will be integrated in a tool for daily practice. It is important to note that the tool will be configured in such a way that the hydrological assessment of small watersheds could be achieved in different levels of detail (A, B, C in Fig. 1).

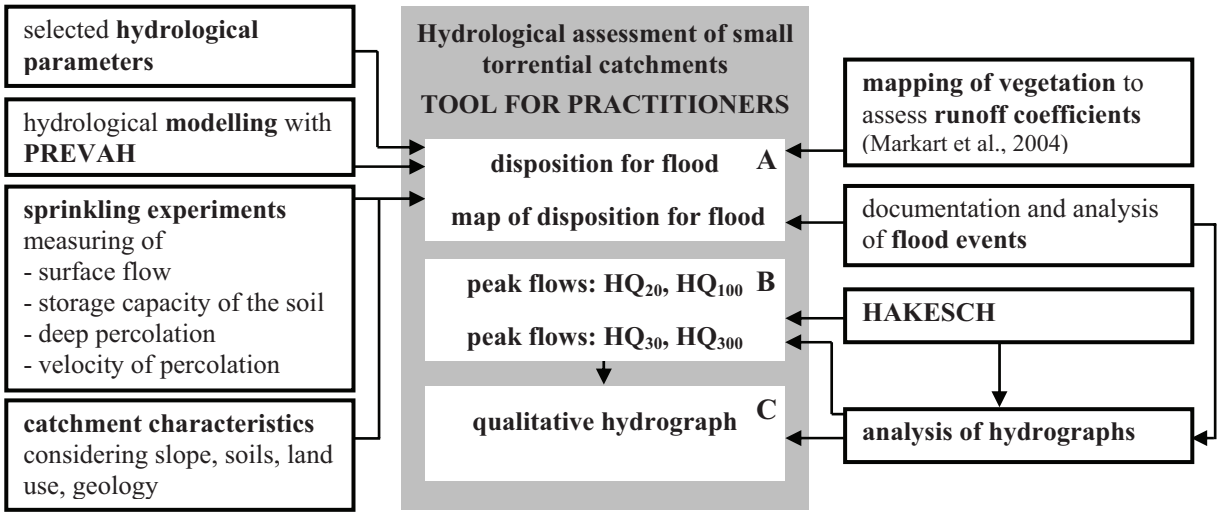

Fig. 1: composition of the tool for practitioners (right and left side: parameters for the development of the tools as made in the project presented; centre: definitive tools)

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The study is based on 43 torrential catchments (<20 km^2) in Switzerland; 34 of them dispose a hydrometric station.

THE THREE SUBUNITS (STEPS) OF THE TOOL

(A) Determination of the flood disposition (HQ_{Disp}): With GIS catchments characteristics (e.g. length of main channel, mean slope, value of relief energy) are elevated and statistically analysed. Thresholds will be defined in order to classify a catchment in terms of HQ_{Disp}. Furthermore spatial analyses and mapping of vegetation lead to a hydrological formation. Sprinkling experiments are introduced to verify this classification. Furthermore, they provide important supplementary information on surface flow and hydrological processes in the soil.

Moreover each of the 43 watersheds will be modelled with PREVAH (Precipitation-Runoff-Evapotranspiration HRU related model). The resulting hydrographs will be relatively compared, again to assess HQ_{Disp} from another perspective.

Altogether the aim of the HQ_{Disp} subunit is to generate basic hydrological knowledge of a watershed, to evaluate the flood disposition, to detect hydrological relevant areas and to identify hazardous catchments where further investigation or even field work are urgently needed.

(B) Estimation of peak flows: HAKESCH will be optimised (in an informatics point of view) and provided with additional tools to improve its quality and accuracy. HAKESCH permits to estimate 20- and 100-year return flows by default. In Switzerland, however, peak flows such as HQ_{30} and HQ_{300} meet the standard of hazard mapping; but there is no standardised approach available to estimate these flood peaks. Analyses of flood events and hydrographs as well as documentation of historical flood events represent the basis of the development of a tool to estimate HQ_{30} and HQ_{300}.

(C) Provision of a qualitative hydrograph: Eventually the documentation and analyses of flood events and hydrographs combined with the estimated peak flows of different return periods form the basis to determine a qualitative hydrograph. For instance, a qualitative hydrograph is an important input parameter for the estimation of sediment delivery.

CONCLUSION

The tool for practitioners to assess the flood hazard of torrential catchments is an integrative method combining different approaches. Besides of an optimised estimation of flood conditions, it provides input parameters for different tasks such as hazard mapping, designing of infrastructure or sediment delivery.

Keywords: flood estimation, flood disposition, HAKESCH, peak flows, qualitative hydrograph, small torrential catchments

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