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Development of a robust method for an estimate of runoff caused by torrential rainfall and a proposal of a warning system

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Forecasting of torrential rainfall and flash floods remains one of the most challenging tasks for hydrometeorological services. Beside the accuracy it has fulfil aspect of timely issue as well. Flash floods occurrence is determined by many factors. The most important are precipitation intensity, temporal and spatial distribution of rainfall but infiltration and retention properties of soil, land cover, land use and terrain must be also considered..
A functional system for a forecast of runoff caused by torrential rainfall and issuing of warning messages should:
a) Work with catchments of area close to horizontal size of convectional storm.
b) Include determination of actual state of potential retention capacity of landscape (e. g. saturation by antecedent precipitation).
c) Use actual precipitation data in very short time step.
d) Implement simple rainfall-runoff model for direct runoff estimation in the catchment.
e) Set a threshold value of runoff or discharge or some multicriteria index, to define a potential risk of flash flood occurrence in some particular region.
Within the research project SP/1c4/16/07 „Implementation of new techniques and stream flow forecasting tools“ (guaranteed by Czech Ministry of Enviroment) a forecasting system for estimation of runoff caused by torrential rainfall is developed.
System is developed in common GIS platform (ArcView GIS 3.x from ESRI) using basic available functions for preprocessing and postprocessing of input and output data to and from rainfall-runoff model and a complex tailor made extension that includes the procedures of rainfall-runoff model.
Input precipitation data are derived from radar quantitative precipitation estimates (QPE) and nowcasting of storm-cell movement. System operates in the scale of small catchments, which areas are typically of size about 5 km2.
Estimation of direct runoff is based on CN method. CN values were derived from land cover data and soil characteristics and change in time according to daily calculated saturation of the soil (rainfall-evapotranspiration-runoff balance). Transformation of direct runoff to catchment response is realized by Clark's unit hydrograph. Rainfall-runoff model parameters were estimated from empirical equations based on selected physio-geographical characteristics of catchments.
Outputs of the system include daily indicative map of precipitation intensity that could cause the direct runoff. However the key output is an estimate of hydrograph for all selected catchment outlets (in cms) including comprehensive information about areal precipitation and runoff amounts (in mm) and time occurrence of peak discharge for each selected catchment.
The procedure is being tested in central and selected regional forecasting offices of Czech hydrometeorological institute.