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Sensitivity of hydrological response of small mountainous catchment to the spatial resolution of precipitation field

Paweł Gilewski and Marek Nawalany

Warsaw University of Technology, Faculty of Buidling Services, Hydro and Environmental Engineering, Warsaw, Poland (pawel.gilewski@is.pw.edu.pl)

The quick hydrological response of mountainous watersheds is one of the primary reason for flooding. The response itself depends on the meteorological forcing and physical characteristics of the catchment. Event-based hydrological modeling can be a useful tool in the flood management, but modeling over mountainous areas is challenging due to the topography and the problems which come out it, e.g., rainfall estimation.

The traditional approach in rainfall-runoff modeling considers assimilation of the precipitation field based on the nearby gauging station. Such method requires spatial interpolation of the point data which particularly in the mountainous areas often leads to rainfall underestimation (e.g., orographic precipitation). Radar estimates provide better spatial resolution of precipitation field, but the data can't be used without proper adjustment due to the specific of radar measurement. Another challenge is the usage of radar precipitation for event-based modeling as this kind of modeling is more sensitive to the input precipitation field than continuous hydrological modeling.

In this study, we have investigated the sensitivity of the semi-distributed hydrological model to the adjusted radar estimates and compared it against hydrological model based on rainfall from the gauging stations. The study area was located in southern Poland nearby the Beskid mountains. For the radar data adjustment, we have used the weighted multiple regression method based on the distance between the meteorological radar and the gages, minimum height visible by the radar and height of the gage. To establish the regression coefficients we have used a long-term dataset which consisted of 10-minutes rainfall for both gauges and radar for three years (2014-2016).

The results are promising and show a significant improvement in the produced hydrographs for several events (for both high and relatively low flow peaks). Moreover, the adjusted radar precipitation can be used to estimate the antecedent moisture conditions in the catchment. The work was supported by the Warsaw University of Technology, Faculty of Building Services, Hydro and Environmental Engineering Dean's Grant (Grant Number: 504/03106).