Influence of geological substrate on runoff formation, a case study: small river catchments in southeastern Serbia of similar size and with comparable pluviographic regimes

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We are witnessing climate change globally and regionally, as well as on a local level. As a result of the expected climate change impact on Southeast Europe, first there is a redistribution of precipitation within the year (frequent extreme events) and then an increase in temperature, which already has a significant effect on evapotranspiration and runoff formed in a particular catchment area. In addition to climatic factors, the geological structure (*i.e.*, the hydrogeological characteristics of the catchment area itself) is of great importance in the formation of runoff. Catchment areas of similar size and under the influence of comparable pluviographic regimes were chosen to define the effect of the catchment's geological substrate on the formation of runoff. Two pilot areas in southeastern Serbia were selected, the first relating to the Vlasina River and the Lužnica, its largest tributary, and the second the Toplodolska and Dojkinacka rivers.

In 1955, in the village of Svodje, the Hydrometeorological Service of Serbia established water level and flow gauging stations on the Lužnica, about 1 km upstream from the mouth of the Vlasina, and on the Vlasina, just before the mouth of the Luznica River. These stations have been in service since their inception. Common to the two gauging stations is that they have relatively the same length of observation time-series and their catchments are almost of the same size (the Luznica at Svodje 318 km^2 and the Vlasina at Svodje 350 km^2). They are neighboring catchments, and their pluviographic regimes are similar.

Monitoring of the Dojkinacka River runoff is conducted at Visocka Rzana, where the gauging station is located only 250 m upstream from that river's junction with the Visocica. Observations began in 1981 and continued with almost no interruption to the present day. At the Topli Do gauging station, which monitors runoff from the catchment of the Toplodolska River, water level observations and flow measurements have been performed since 1990, albeit with frequent interruptions. The catchments are of similar size (hydrological areas about 135 km^2) and they are also under the influence of a similar pluviographic regimes (adjacent catchments).

The following analyses were undertaken to define the effect of the geological substrate of the catchments on the formation of runoff. The hydrographs of adjacent catchments were compared and showed that in mostly karst catchments the peaks were lower and lagged behind flood wave peaks in mostly non-karst catchments. Autocorrelation analyses indicated that largely karst catchments had longer memories than non-karst catchments. The base flow index of the catchments with karst was much higher than of those without karst. Finally, water balance equation calculations revealed that the runoff coefficient of non-karst catchments was considerably higher than of those that featured carbonate sedimentary rocks.