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Alterations of ecological flow variables in Lithuanian rivers under climate change conditions

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Ecological flow determines the water quantity needed to sustain river functions and healthy fluvial ecosystems. This measure is important when managing rivers and aiming to meet WFD requirements of good ecological status. In Lithuania, only the definition of environmental flow is defined and this value is quantified as either an 80% or 95% probability of low flow (Q30) during the warm period. However, the ecological flow is in the first step of its determination. Existing anthropogenic pressures and changing climate are expected to bring new stresses on rivers, and new challenges for sustaining ecological flows in fluvial ecosystems. The aim of this study is to evaluate the effects brought by different climate change scenarios (RCP2.6, RCP4.5 and RCP8.5) on potential ecological flow variables (minimum, average and maximum of Q30) of Lithuanian rivers. Four low-land rivers, namely Verknė, Širvinta, Šešupė, and Bartuva were studied. All of these rivers represent different hydrological regions and feeding characteristics. The study was based on hydrological modelling performed by HBV software, assessing the temporal changes in flow regime as well as changes in ecological flow variables. The projections were made for the near future (2021-2040) and the far future (2081-2100). The results have shown that Šešupė, which is highly dependent on surface runoff (snow melt and precipitation), was the most vulnerable to climate change. It would experience the greatest decrease in discharge during the low-flow periods (30-60%). In the near future, the duration of Q30_min in Šešupė would face an increase by 4-9 days and an increase by 8-32 days in the far future. RCP8.5 scenario would have the greatest impact on flow regime patterns. The other studied rivers would experience less dramatic changes in low flow parameters in the near future. The Bartuva River as a precipitation-fed river would have an increase in minimum and average low flow discharges. Verknė and Širvinta, both having groundwater feeding as a dominant component, in the far future will face a medium decrease in discharge (lower by 20% and 30% respectively) and a moderate increase in the duration of Q30_min by 7-16 and 6-15 days for each river respectively depending on RCP scenario. Although modelling flow regimes is a very important approach for projections of potential ecological flow variables, further studies incorporating additional parameters of river health, such as changes in water temperature, would give a better picture and deeper understanding of the behaviour of ecological indicators in the future.

Keywords: ecological flow, low flow, Lithuanian rivers, climate change, projections

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