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Development of the low flow forecasting models for the Sava River's tributaries

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The Sava River runs 945 km from northwest to southeast beginning in Slovenia, continuing over Croatia and Bosnia and ending in Serbia and Montenegro at its confluence with the Danube in Belgrade. It contributes approximately 25% of the Danube's total discharge and has a drainage area of approximately 96400 km^2 which presents 15% of the Danube River Basin. In Slovenia the Sava River Basin comprises the central part of the country. There are four in-stream hydropower stations situated on the Slovenian part of the Sava River. Good and accurate long–term low flow forecasts are especially important in the fields of sustainable water management, water rights, water supply management, industrial use of freshwater, optimization of the reservoir operations for the production of electric energy and other water-related disciplines in the Sava River Basin.

The dynamics of the flow rates on the recession part of the streamflow hydrograph is usually modelled as:

$Q_{t+n} = Q_t \, e^{(-kn)}$

where Q_{t+n} is flow rate at n-days after the time of the forecast t, Q_t is the flow rate at the time of the forecast, e is the base of the natural logarithm function, k is the recession constant and n is the number of days in advance for which the forecast is made.

Analysis of the 10-year long streamflow recession data for the Sava River's tributaries showed great variability in the behaviour of individual recession segments, which meant that usage of single numerical value for the recession constant wouldn't result in good accuracy, when the models are operationaly run and used on a daily basis.

By using the decision trees machine learning method and analysis of the recorded recession streamflow data we modelled the recession 'constant' k as being a function of the flow rate at which the 7-day low flow forecast is made and the decrease of the flow rate from the previous day. Low flow forecasting models for most of the Sava River's Slovenian tributaries were developed and verification of the results on the flow data from year 2003 show really good results and improved accuracy in comparison to the low flow forecasting models in which a single numerical value is used as the recession 'constant'.