Comparison of three different streamflow naturalization methods: an application for the Seine river basin

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Observed streamflow time series are influenced by climate variations and human-induced perturbations. Nowadays, estimating the natural river flows appears essential in different fields, such as in water resources management, the legislation context or climate change studies. In the last two decades, several naturalization methods have been developed to estimate a naturalized streamflow series from an influenced one. However, they have been designed for specific applications and there is a lack of estimation of the associated uncertainties.

Our study analyzes the respective strengths and weaknesses of three identified groups of methods. The first one, namely the neighborhood method, is based on a regionalization from geographically close catchments. The second one, namely the extension and reconstitution method, implement a hydrological model on the studied basin to estimate its naturalized streamflow time serie. Finally the third one is derived from a water balance analysis. These methods were compared on the case study of the Seine River Basin by considering the influence of the four large artificial reservoirs and focusing on a few flow gauging stations downstream. Since hydrological models are essential for the application of some naturalization methods, we used the GR5J model(implemented in the airGR R package*), and a modified version including a dam module.

Results show that the different methods converge to similar impact assessments of reservoirs. However, significant differences appear between the natural low-flow estimates. Uncertainty estimates were also quantified and compared.

*Coron L., C. Perrin, O. Delaigue, G. Thirel and V. Andréassian (in prep.) - airGR: A suite of lumped hydrological models in an R-package. Environmental Modelling and software.