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Combining statistical learning and geostatistical approaches in a spatiotemporal framework for low flow estimation

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This paper aims to develop a spatiotemporal model to estimate monthly low flow quantiles Q95 [P(Q<Q95=0.05)] standardized by catchment area in Austria. Our dataset consists of 325 gauging stations that where consistently monitored between 1976 to 2015, and it covers about 60% of the national territory of Austria.

In a first step we are adapting a spatiotemporal model initially designed for modeling air pollution data. This approach is based on empirical orthogonal functions (EOF), that should capture the temporal structure of the spatiotemporal model. The EOFs are weighted by regression coefficients estimated by universal kriging. We extend the model by using GLM-boosting, LASSO, Principal Component Regression (PCR) and Random Forest (RF) for selecting the regression coefficients of the EOFs. Furthermore, we do not limit the kriging structure of the residual field to geographical coordinates but use a broader approach of physiographic kriging. In a second step we implement separate models for the mean parts of the model and the residual parts of the model. The mean field is defined by statistical learning methods as RF, GAM-boosting, LASSO and Support Vector Machines (SVM). For the residual field we define two different approaches, either the method developed in the first step or spatiotemporal kriging.

Model performance is evaluated by cross validation and the best model is selected by the mean squared error (MSE).