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Comparison of low flow indicators of small lowland catchments of Northeast Germany

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Recent analyses on measured discharge time series and projections of future discharge using model chains predict more frequent and more severe low flows for streams in the Northeast German lowlands. Only a few comparative studies on low flow hydrology of small catchments (< 500 km^2) of this region exist. Especially, the complex Pleistocene formed geohydrology with multilayered aquifers and missing agreement of surface and subsurface catchment boundaries complicate model based analyses. Previous studies showed differences in discharge patterns of small catchments according to climatic as well as geohydrologic differences. However, detailed Analyses on low flow dynamics of these catchments are missing. Knowledge on processes driving low flow is essential in order to develop effective adaption strategies to sustain minimum runoff. In our study we aim at identifying meteorological indicators for low flows in small catchments of the Northeast German lowlands. Indices derived from precipitation and potential evapotranspiration data on different time scales and lags were used to identify the main processes and compare the different catchments with each other.
Sixteen catchments were selected which had long (> 20 years) time series and only up to moderate anthropogenic impacts. The annual minima of the 30-day mean flow (NM30Q) were calculated. Standardized indices of precipitation and potential evapotranspiration with an aggregation of 1 to 48 months as well as previous years, half years and seasons served as explanatory variables. First, an iterative algorithm based on support vector machine regression was chosen in order to optimize the number of explanatory variables. A bootstrapping approach was applied for validation purpose and all data was merged in one data set. The potential evapotranspiration of the last 1, 6, 12 and 36 month, and the precipitation of the previous winter season and 48 months were identified to be the most relevant parameters. For the validation data they were able to explain $R^2 = 0.50$ of the NM30Qs. Previous high potential evapotranspiration and small winter and long term precipitation sums indicate low NM30Qs. As a second step, the optimized set of low flow indicators was used to compare the different catchments. The correlation structure between the low flow indicators, NM30Qs and catchment properties were analyzed. We expect catchments with higher correlation to potential evapotranspiration variables to react more pronounced to climate change. Further, correlations of the results with catchment properties derived by GIS analysis and our previous studies allowed the formulation of hypotheses on processes and anthropogenic impacts. The results are useful to improve adaption measures to sustain minimum runoff in small catchments of the Northeast German lowlands.