



## **Characteristic patterns and processes from non-linear analysis of soil water and streamwater time series in the forested catchment Lange Bramke, Harz Mountains, Germany**

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Long-term monitoring of headwater semi-natural catchments is used to document persistence and changes in ecosystems. At three headwater catchments in the Bramke basin in Northern Germany, physical and chemical variables in rainfall, soil solution from various depths (20–300 cm) and streamwater have been monitored. The Lange Bramke catchment is largely covered by a Norway spruce (*Picea abies*, Karst.) stand planted in the 1950ies. Over 29 years, 4310 water samples from streamwater and 5475 soil water samples were analysed for major constituents. Both linear methods (principal component analysis (PCA) and cross correlation (CC)) as well as non-linear methods (isometric feature mapping (ISOMAP) and maximum variance unfolding (MVU)) were used to analyze the spatiotemporal patterns of dissolved major ion concentrations in soil solution and streamwater. This approach provides a multiscale characterisation of links between soil water and streamwater at the catchment scale. Pattern identification augments the interpretation of processes in terms of transport and storage. The long time scales were dominated by trends in ions implicated in soil acidification. This reflects the decreasing input of acid deposition. At the annual scale, where hydrological effects dominate, each of the three adjacent catchments showed different patterns. Various empirical and process-based models have been applied in the past to the Bramke catchments. Results of the data-oriented approach can be used to indicate the potential and limits of process-oriented models for this data set.