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Multivariate analysis of a small pleistocene catchment: tracing hydrological change

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The water budget of catchments in north-east Germany has decreased considerably over the last decades. Especially small catchments are affected due to the small amount of water stored within. Climate projections for the next decades hint to even more negative impacts on the water budgets of these catchments. Therefore, a new concept of water resource management for this region must be developed, including counter measures to extreme events such as low and high flow conditions. In order to manage a hydrological system one needs to know the typical behavior and be able to effectively counteract if needed.
Within the network activity INKA-BB (Inovationsnetzwerk Klimaanpassung Brandenburg Berlin) dealing with possible adaptation measures to climate change in the Brandenburg and Berlin region, this study aims at identifying the typical hydraulic behavior of the Fredersdorfer Mühlenfließ catchment located north-east of Berlin as a basis for a sustainable water resource management concept.
Established schemes are followed, including the application of numerical geochemical and hydraulic models as well as chemical graphical interpretation approaches. A common problem is the sparse spatial as well as temporal resolution of the data at hand. Here, these schemes are too inflexible and vague with respect to analyzing and parameterization of complex features used for identifying operative hydraulic-geochemical processes including intensive non-linear interactions. Hence, methods must be applied that are able to effectively utilize the limited information available. Ordination methods such as the Principle Component Analysis (PCA) or the non-linear Isometric Feature Mapping (Isomap) can provide such a tool. Ordination methods are used in order to derive a meaningful low-dimensional representation of a high-dimensional input data set. The approach is based on the hypothesis, that the amount of processes which explain the variance of the data is relative low although the intensity of the processes varies in time and space. Therefore, the resulting output dataset can be interpreted in reference to the effective hydrological processes, controlling the system.
The aim of this study is the identification of the catchment behavior under changing hydrological boundary conditions. The interpretation of hydraulic and hydrochemical data sets with innovative non-linear statistics allows the identification of spatio-temporal dynamics of the dominating/active processes and the cause/effect chain of climate change impacts on water and substance cycles. A comparison of the thus derived results with other catchments throughout the region can highlight general relationships as a basis for a sustainable water resource management valid for pleistocene catchments with high risk of water stress.