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The changing Water Balance in Saxony

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A first approach to understand mechanisms of the water balance under a changing climate is the analysis of observations in the past. Due to a breaking point analysis of temperatures between 1961 and 2014 it is possible to determine two time slots of reasonable durations, the first from 1961 to 1987 and the second from 1988 to 2014. The time slots feature an average temperature change of appoximately +0.8 K. Although the temperature is only loosely coupled with precipitation - the most important driver of the water balance - it allows for a first analysis of water balance sensitivity.
Over the whole time frame the hydrograph separation method DIFGA is carried out for 98 catchments covering a third of Saxony. DIFGA quantifies the water balance according to the storage equation P = ETa + R + dS on a daily basis with different fast and slow runoff components from storages using optimized storage coefficients. The resulting water balance data is subject to a sensitivity analysis of absolute and related components over the two time slots.
The most obvious changes can be found during the first vegetation period from April to June. The decreasing precipitation and the higher evaporative demand result in less runoff and ground water recharge. This leeds to a worse water supply for agriculture especially in the drier parts of Saxony. Less obvious although existent is the change of the water balance on a half year or an annual basis. The shift of vegetational activity to earlier weeks can be seen in an increasing evapotranspiration during winter. Surface runoff decreases significantly in summer as does the overall disposition to runoff. Due to the high inertia of ground water recharge, this slow component decreases over the whole year.
For the database a clustering method is implemented. Three main groups of water balance reaction in catchments are identified: (1) moderate mean changes, (2) remarkable changes in slow runoff components and (3) significant changes in fast runoff components. These groups allow the evaluation of the susceptibility of catchments and regions to climate change. As a consequence it can be used as an indicator for further analysis under future climate change.

The DIFGA method allows the regional quantification of actual evapotranspiration, surface runoff, fast and slow groundwater components and therefore ground water recharge from observations. The sensitivity analysis presented here gives the degree of influences from the particular climatic parameter temperature onto regional water balance.