Geophysical Research Abstracts
Vol. 19, EGU2017-9254, 2017
EGU General Assembly 2017

Surface water quality deterioration during low-flow

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Water quality deterioration during low streamflow has mostly been linked to a lower dilution potential for pollutants. Some studies have also found spatial heterogeneities and a different behavior of different water quality parameters. Even though the general mechanisms that cause water quality changes during low-flow are well understood, only a few efforts have been made to explain the differences in the magnitudes of observed deteriorations. We investigated 72 catchments across the federal state of Baden-Wuerttemberg, Germany, for changes in water quality during low-flow events. Data from the state's water quality monitoring network provided seven water quality parameters (water temperature, electrical conductivity, concentrations of chloride, sodium, sulfate, nitrate and phosphate), which we statistically related to streamflow variability. Water temperatures increased during low flow in summer but decreased during low flow in winter. Nitrate concentrations revealed high spatial heterogeneity with about one third of the stations showing decreasing values during drought. For all other parameters concentrations rose during low-flow with only a few exceptions. Despite consistent trend directions, the magnitudes of changes with streamflow differed markedly across the state. Both multiple linear regression and a multiple analysis of variances were applied to explain these differences with the help of catchment characteristics. Results indicated that for sulfate and conductivity geology of the catchments was the most important control whereas for chloride, sodium and nitrate sewage treatment plants had largest influence. For phosphate no clear control could be identified. Independent from the applied method, land use was a less important control on river water quality during drought than geology or inflow from sewage treatment plants. These results show that the effects of diffuse and point sources, as well as those of natural and anthropogenic sources differ for different water quality parameters. Overall, a high diversity of potential water quality deterioration signals needs to be considered when the ecological status of rivers is to be protected during low-flow events. An analysis of catchment characteristics helps to narrow down this diversity and focus on the most important parameters.