



Analysis of trends and breakpoints in observed discharge time series in Lower Saxony, Germany

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Historical streamflow in the federal state of Lower Saxony, Germany was analyzed for potential trends and breakpoints. The investigation was based on time series of daily mean discharge values in the periods 1951 to 2005, for which 34 gauging stations showed a sufficient record length, and 1966 to 2005, for which 110 gauges were available. Indices characterizing both high and low flow conditions, as well as the mean discharge within a year and the individual seasons, were extracted from the daily time series and subjected to statistical analyses, including the estimation of trend direction, slope and local and global significance, as well as a breakpoint analysis. Simultaneously, several precipitation and temperature indices were tested for trends in the exact same manner, in order to investigate alterations in the atmospheric driving forces as potential causes for changes in the hydrological regime. 263 precipitation and 18 temperature stations provided the daily data from 1951 to 2005. For the discharge the largest significant changes could be noted in summer, where low, high and medium flows decreased throughout. Spatially, these downward trends proved strongest in the eastern half of Lower Saxony. A breakpoint analysis revealed that a large portion of gauging stations feature breaks in the summer indicator time series in 1988, after which a trend reversal, i.e. an increase in discharge, was observed. In spring and fall, a spatial differentiation between an increase in the northwest and a decrease in the southeast were found for the low flow. In winter, an increasing tendency in all discharge portions could be noted, but merely the trends in the flood indices proved field significant. Generally, the trends in discharge were found consistent with those in temperature and especially precipitation. For the mean temperature, consistently strong, positive, significant trends were detected, while the analysis of the precipitation indices revealed increases in winter and decreases in summer.