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Detecting and visualizing structural changes in groundwater head time series

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Since the fifties of the past century the dynamic behavior of the groundwater head has been monitored at many locations throughout the Netherlands and elsewhere. The data base of the Geological Survey of the Netherlands contains over 30,000 groundwater time series. For many water management purposes characteristics of the dynamic behavior are required, such as average, median, percentile etc.. These characteristics are estimated from the time series. In principle, the longer the time series, the more reliable the estimate. However, due to natural as well as man induced changes, the characteristics of a long time series are often changing in time as well. For water management it is important to be able to distinguish extreme values as part of the 'normal' pattern from structural changes in the groundwater regime.

Whether or not structural changes are present in the time series can't be decided completely objective. Choices have to be made concerning the length of the period and the statistical parameters. Here a method is proposed to visualize the probability of structural changes in the time series using well known basic statistical tests. The visualization method is based on the mean values and standard deviation in a moving window. Apart from several characteristics that are calculated for each period separately, all pairs of two periods are compared and the difference is statistically tested. The results of these well known tests are combined in a visualization to supply to the user comprehensive information to examine structural changes in time series.