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Application of nonparametric trend analysis to concentration time series

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Groundwater contamination resulted from chemical releases related to anthropogenic activity often proves to be a persistent feature of the affected groundwater regime. The affected volume (i.e. where the concentration of hazardous substances exceeds a certain threshold) is a complex and dynamic entity commonly called “contaminant plume”. The plume can be described as a spatially dependent concentration pattern with temporal behavior. Persistent plumes are regularly monitored, concentration data gained by repeated sampling of monitoring points and laboratory analyses of the samples are used to assess the actual state of the plume. The change of the concentrations at certain points of the plume facilitates the assessment of the temporal behavior of the plume. Repeated sampling of the monitoring points provides concentration time series.

Concentration time series are evaluated for trends. Methods include parametric (regression using least squares) and non-parametric methods. Mann-Kendall statistic is a commonly used, well known non parametric method.

When using Mann-Kendall statistics consecutive concentration data are compared to each other, their cumulative relation defines Mann-Kendall statistic ‘S’. However, when comparing concentration data laboratory uncertainties are usually neglected. Allowing for laboratory uncertainties, rises the question of what concentrations are considered equal, less or more than other concentrations. In addition aggravating concentration data will change the previous equal – more - less status of two concentrations, thus changing the Mann-Kendall statistics value, which sometimes results in differences in trend significance.