

Evaluation of trend in contaminant concentration time series

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As a result of anthropogenic activity the groundwater at many industrial sites are often contaminated by various chemicals. The affected groundwater regime is a complex and dynamic system on its own, which interacts with the released chemicals increasing the complexity of the system. The actual dissolved concentration of the contaminants is dependent on far too many factors, to be possible to account individually for each of them. The measurable concentration changes are sum results of these factors, therefore trend evaluation of concentration changes provide a tool that can support decision making process.

However, trends in concentration changes are often difficult to evaluate. Different time series evaluation methods can lead to different results, and as new data is added to a time series the resulting trends can change using the same method.

The two most common trend evaluation method groups are regressions using least squares and Mann-Kendall statistic. Both groups contain several slightly different procedures, like the most commonly applied linear regression and the seasonal Mann-Kendall.

It will be demonstrated, that linear regression and Mann –Kendall statistics applied on the same concentration time series data can result in different trends, besides increasing or decreasing trends in concentration time series may not be prevailing. It is advisable that it is not sufficient to evaluate trends solely at a certain point of the data collection, rather series of evaluation procedures are required, backwards in time if necessary, and as new data is added to the time series, the evaluation procedure should be repeated.

It is generally accepted, that a time series with four data is a minimum requirement to facilitate trend evaluation. The proposed evaluation of a time series with n data point ($n \geq 4$) should include $n-3$ evaluation procedures for 4, 5, 6 ... n data points. The results also form a time series. Finally it is proposed, that at some cases cumulative time average is also a suitable approach.