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# Data quality assurance in monitoring of wastewater quality: Univariate on-line and off-line methods

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**Abstract:** To make water quality monitoring networks useful for practice, the automation of data collection and data validation still represents an important challenge. Efficient monitoring depends on careful quality control and quality assessment. With a practical orientation a data quality assurance procedure is presented that combines univariate off-line and on-line methods to assess water quality sensors and to detect and replace doubtful data. While the off-line concept uses control charts for quality control, the on-line methods aim at outlier and fault detection by using autoregressive models. The proposed tools were successfully tested with data sets collected at the inlet of a primary clarifier, where probably the toughest measurement conditions are found in wastewater treatment plants.

**Keywords:** Data quality assessment; on-line wastewater monitoring; univariate methods

## INTRODUCTION

Thanks to important technological developments regarding on-line water quality sensors, in situ monitoring stations are increasingly being used to identify and describe pollution dynamics in water bodies. Huge data sets consisting of a large number of physical-chemical parameters are then generated with those systems. Since sensors are still subject to functional, technical and operational constraints, and even more under the challenging measuring conditions that prevail in wastewater systems, they are disturbed by bias, drift, precision degradation or total failure effects that cause the reliability of measurements to decrease. Those situations can lead to faulty conclusions and to incorrect use of the data. Consequently, meaningful water quality data will intrinsically depend on the application of quality assessment and quality control practices to ensure that high quality data is being collected.

Different methods have been developed for data quality assessment in different fields, the main goal being the identification of out-of-control situations caused by systematic or gross errors (Thomann, 2008). However, there is still a long way to bring the many academic developments into practice in the water sector, nowadays most of the data assessment process is done by using inefficient and laborious manual procedures. The sheer size of the data sets to be dealt with makes the data assessment process crucial for an effective monitoring strategy. In this paper an automatic data quality assurance procedure with a practical orientation is presented. By combining off-line methods for data quality control and univariate on-line methods for data quality assessment, information from single variables is extracted to assess sensors measuring quality and to identify outliers, noise, and potential sensor faults. Once the individual signals are data quality controlled they can be used for multivariate analysis (Alferes et al., 2012). The developed algorithms are illustrated with automated monitoring systems installed at the inlet of a wastewater treatment plant.

## MATERIALS AND METHODS

### Case study

Two automated monitoring stations (RSM30, Primodal Systems, Canada) have been installed at the inlet and at the outlet of a primary clarifier line of the 700,000 PE municipal treatment plant Lynetten (Copenhagen, Denmark) to study the inflow