

Assessment of river monitoring based on discrete and continuous methods

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River monitoring is traditionally based on manual spot sampling and subsequent laboratory analysis. For example in Austria, typical monitoring frequencies are 1 – 2 samples per month. Such programs deliver a good base for evaluating long-term trends but are somewhat limited with respect to the assessment of short- or mid-term transient pollution (Ballantine and Davies-Colley, 2010).

In comparison, continuous river water quality monitoring can provide data of significantly higher time resolution and subsequently an improved understanding of system dynamics. A successful operation of continuous river water monitoring stations requires the application of a number of automated systems which take care of different aspects such as easy integration of different probes, consistent and manufacturer independent data format, automated data plausibility evaluation and automated monitoring station control. Such an intelligent water monitoring framework has been recently been developed at the Vienna University of Technology (Winkler et al., 2011).

Figure 1 shows the comparison of the yearly load for the parameters chloride, $\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$ based on the results from a traditional discrete monitoring program and a continuous monitoring station. Both load calculations have been based on the same set of flow data (1h-resolution), the yearly load of the discrete sampling method has been calculated according to a method proposed by ICPDR (ICPDR, 2007) – these loads have been chosen as the reference load. In a first approach only soluble parameters have been investigated in detail.

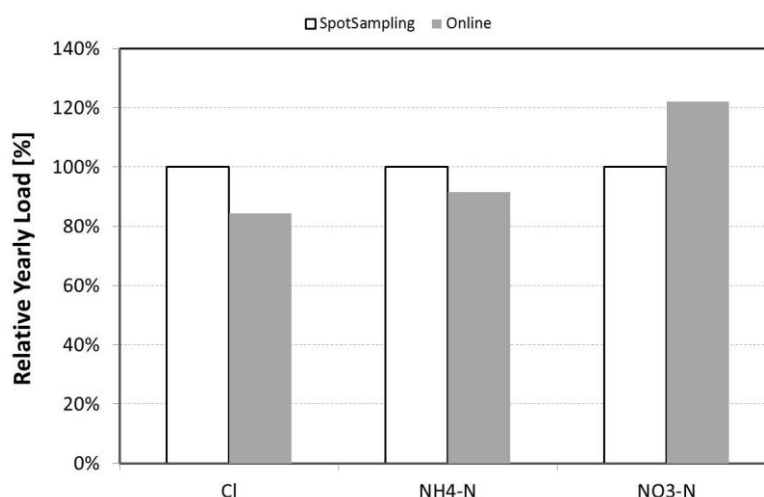


Figure 1: Relative yearly load based on discrete and continuous monitoring methods

A comparison of the concentration data of the different methods shows a satisfactory agreement for chloride and $\text{NO}_3\text{-N}$ (Figure 2). It needs to be emphasized that the probes of the continuous monitoring station were calibrated based on reference data from a different laboratory; no inter-calibration of the two laboratories has been carried out yet. In addition, Figure 2 does not consider the uncertainties of the lab methods.

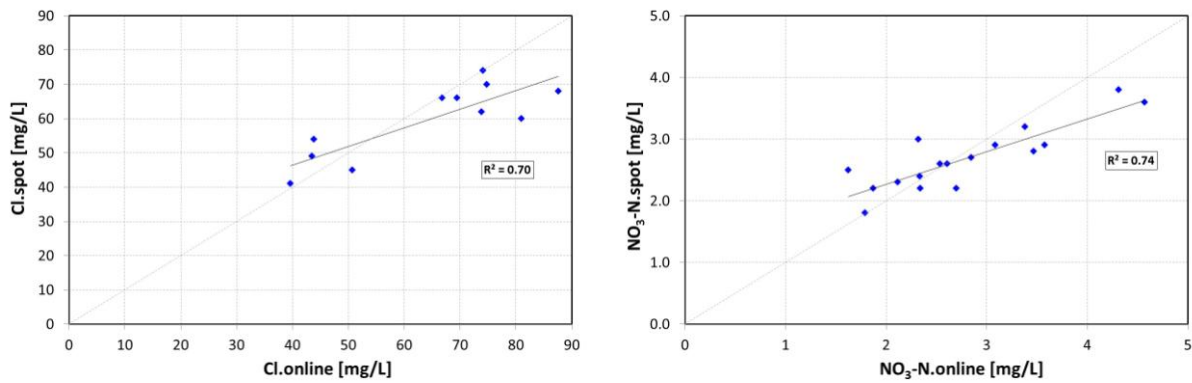


Figure 2: Comparison of concentration data from discrete ('spot') and continuous ('online') monitoring methods for chloride (left) and nitrate-N (right)

Though, in comparison to the discrete method, the continuous monitoring tends to deliver slightly lower concentrations for chloride as well as NO₃-N and the same flow data set is used for both methods, the resulting yearly load of the continuous monitoring method is lower for chloride, but higher for NO₃-N.

It appears that this is related with the different properties of these two parameters (Figure 3). While the chloride-load is mainly influenced by point discharges, the NO₃-N-load is considerably influenced by varying flow. It can be assumed that the latter is related to surface runoff and groundwater discharge during storm weather events.

Figure 3 shows in addition, that the two methods show a different contribution pattern of the monthly loads to the respective total yearly load. For chloride, the continuous monitoring method shows a peak in April and an overall decreasing load trend over the year. The discrete method also shows a mainly decreasing load trend over the year, but a steady load increase during the last quarter. For NO₃-N both load trends follow the general pattern of the flow, but especially in the last quarter the two methods deliver different patterns. The flow peaks in September and December result in corresponding NO₃-N-load peaks with both methods; in both cases the continuous method shows a stronger response. In addition, it also shows a more pronounced response to the lower flows during October and November. It is assumed that this is due a more complete recording of the transient system states with the continuous method.

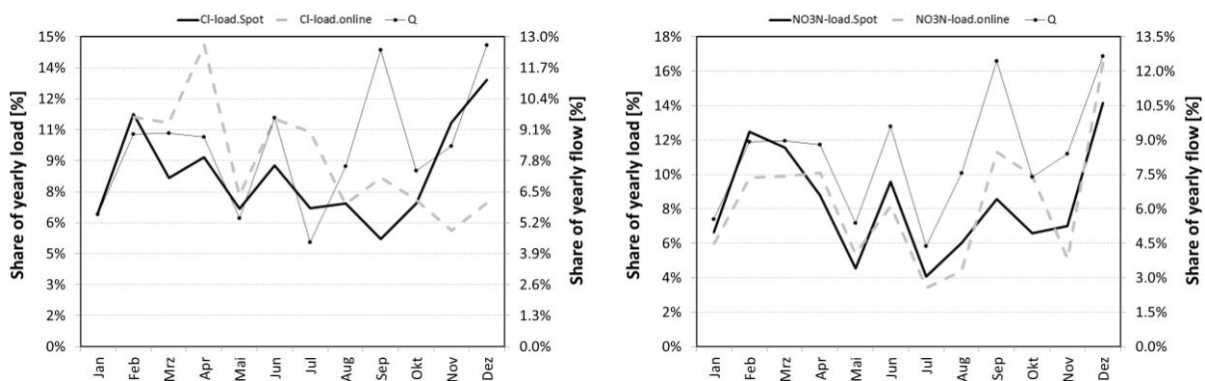


Figure 3: Comparison of concentration data from discrete ('spot') and continuous ('online') monitoring methods for chloride (left) and nitrate-N (right)

Continuous river monitoring appears to provide a more detailed insight in the dynamics of the observed river stretch in addition to delivering generally useful information such as yearly load data. Practical experience shows that especially optical measurement principles (turbidity, UV-absorption) provide plausible and useful data at comparably low maintenance demand. Omitting sample pumping and

filtration systems usually significantly reduces potential failures of monitoring stations – unfortunately, the latter is not always practicable due to specific properties of the monitoring location. Intelligent monitoring network concepts and further progress in the field of water quality instrumentation will foster a broader application of continuous monitoring in practice.

References

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