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Optimization of water quality monitoring networks: The case of Freiberger Mulde River in Eastern Germany

Thuy Hoang Nguyen (1,2), Björn Helm (2), Hiroshan Hettiarachchi (1), Serena Caucci (2), and Peter Krebs (2)

(1) United Nations University, Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES), Germany (hnguyen@unu.edu), (2) Technical Universität Dresden (TUD), Institute of Urban and Industrial Water Management

The surface water quality monitoring networks are crucial to manage and protect the water resources. Nevertheless, the established monitoring networks are sometimes quite outdated when compared to the urbanisation and economic development. One of the reasons is the lack of a systematic designing process which includes the selection of water quality parameters, sampling frequencies and identifying the sampling sites. This study attempts a small contribution to optimising the design of water quality monitoring networks in rivers, our most important inland water resource. First, a systematic search was conducted to identify the most common designing methods and their applications, using online search engine and citation database. In total, 1313 records were screened with titles, and where necessary, with abstracts, but only 59 records were relevant for data analysis. The results showed that not so many studies addressed all three aspects of monitoring design but rather focusing only on one or two aspects in their research. In addition, the parameters used for analysis were mostly the general physiochemical variables, but rarely considered the impacts of other substances such as heavy metals and industrial/ agricultural pollutants. Through the review, multivariate statistical analysis appeared to be a promising tool for designing monitoring network due to its usefulness in dealing with complex dataset but not so demanding in analytical skills. Second, we applied the above findings to optimise the operational monitoring network for Freiberger Mulde River in Eastern Germany. The priority substances relating to river chemical status, according to the newest Surface Water Ordinance, were included. In total,30 parameters at 30 sites during an 18-year period (1999 – 2016) were analysed. Principle Component Analysis and Factor Analysis reduced the sampling sites and characterised water quality parameters to monitor. Confidence Interval was used to identify the sampling frequencies for each specific monitoring parameter. Through the application, the monitoring cost for Freiberger Mulde River is expected to optimise while the monitoring objectives are still ensured.