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Modelling of in-stream nitrogen and phosphorus concentrations using different sampling strategies for calibration data

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It is known that a good evaluation and prediction of surface water pollution is mainly limited by the monitoring strategy and the capability of the hydrological water quality model to reproduce the internal processes. To this end, a compromise sampling frequency, which can reflect the dynamical behaviour of leached nutrient fluxes responding to changes in land use, agriculture practices and point sources, and appropriate process-based water quality model are required. The objective of this study was to test the identification of hydrological water quality model parameters (nitrogen and phosphorus) under two different monitoring strategies: (1) regular grab-sampling approach and (2) regular grab-sampling with additional monitoring during the hydrological events using automatic samplers.
First, the semi-distributed hydrological water quality HYPE (Hydrological Predictions for the Environment) model was successfully calibrated (1994-1998) for discharge (NSE = 0.86), nitrate-N (lowest NSE for nitrate-N load = 0.69), particulate phosphorus and soluble phosphorus in the Selke catchment (463 km2, central Germany) for the period 1994-1998 using regular grab-sampling approach (biweekly to monthly for nitrogen and phosphorus concentrations). Second, the model was successfully validated during the period 1999-2010 for discharge, nitrate-N, particulate-phosphorus and soluble-phosphorus (lowest NSE for soluble phosphorus load = 0.54).
Results, showed that when additional sampling during the events with random grab-sampling approach was used (period 2011-2013), the hydrological model could reproduce only the nitrate-N and soluble phosphorus concentrations reasonably well. However, when additional sampling during the hydrological events was considered, the HYPE model could not represent the measured particulate phosphorus. This reflects the importance of suspended sediment during the hydrological events increasing the concentrations of particulate phosphorus. The HYPE model could reproduce the total phosphorus during the period 2011-2013 only when the sediment transport-related model parameters was re-identified again considering the automatic sampling during the high-flow conditions.