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Assessing the effects of sampling design on water quality status classification

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The Water Framework Directive (WFD) requires continued reporting of the water quality status of all European waterbodies, with this status partly determined by the time a waterbody exceeds different pollution concentration thresholds. Routine water quality monitoring most commonly takes place at weekly to monthly time steps meaning that potentially important pollution events can be missed. This has the potential to result in the misclassification of water quality status. Against this context, this paper investigates the implications of sampling design on a range of existing water quality status metrics routinely applied to WFD compliance assessments.
Previous research has investigated the effect of sampling design on the calculation of annual nutrient and sediment loads using a variety of different interpolation and extrapolation models. This work builds on this foundation, extending the analysis to include the effects of sampling regime on flow- and concentration-duration curves as well as threshold-exceedance statistics, which form an essential part of WFD reporting. The effects of sampling regime on both the magnitude of the summary metrics and their corresponding uncertainties are investigated.
This analysis is being undertaken on data collected as part of the Hampshire Avon Demonstration Test Catchment (DTC) project; a DEFRA funded initiative investigating cost-effective solutions for reducing diffuse pollution from agriculture. The DTC monitoring platform is collecting water quality data at a variety of temporal resolutions and using differing collection methods, including weekly grab samples, daily ISCO autosamples and high resolution samples (15-30 min time step) using analysers in situ on the river bank. Datasets collected during 2011-2013 were used to construct flow- and concentration-duration curves. A bootstrapping methodology was employed to resample randomly the individual datasets and produce distributions of the curves in order to quantify the uncertainty associated with the different sampling temporal resolutions and collection methods. This analysis was repeated using temporally degraded versions of the high-resolution dataset to assess specifically the impact of temporal resolution alone on the estimated distributions. Threshold- exceedance statistics were also calculated for each experimental dataset. The principal outcome of the ongoing work to date is a quantification of the impact that sampling design decisions have on well-used water quality metrics and the uncertainty associated with their calculation, which, in turn, is vital if accurate evaluations of water quality status and compliance are to be made.