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Investigating the impact of data uncertainty on the estimation of catchment nutrient fluxes.

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Changing climate and a growing population are increasing pressures on the world's water bodies. Maintaining food security has resulted in changes in agricultural practices, leading to adverse impacts on water quality. To address this problem robust evidence is needed to determine which on-farm mitigation strategies are likely to be most effective in reducing pollutant impacts. The introduction of in-situ quasi-continuous monitoring of water quality provides the means to improve the characterisation of pollutant behaviour and gain new and more robust understanding of hydrological and biogeochemical flux behaviours in catchments. Here we analyse a suite of high temporal resolution data sets generated from in-situ sensor networks within an uncertainty framework to provide robust estimates of nutrient fluxes from catchments impacted by intensive agricultural production practices.

Previous research into nutrient flux estimation has focused on assessing the uncertainty associated with the use of different load models to interpolate or extrapolate nutrient data where daily or sub-daily discharge data are generally available and used with lower resolution nutrient concentrations. In such studies examples of datasets where paired discharge and nutrient concentrations are available are used as a benchmark of 'truth' against which the other data models or sample resolutions are tested. This work illustrates that even given high temporal-resolution paired datasets, where no load model is necessary, there will still be significant uncertainties and therefore demonstrates the importance of analysing such data within an uncertainty framework to obtain robust estimates of catchment nutrient loads.

This study uses 15-minute resolution paired velocity and stage height data, in order to calculate river discharge, along with high temporal resolution (15 or 30 minute) nutrient data from four field sites collected as part of the Hampshire Avon Demonstration Test Catchment project between 2011 and 2013. The high-resolution velocity and stage height data illustrate seasonal channel dynamics and highlight why the use of a single stage-discharge curve for discharge estimation is often inappropriate in small headwater research catchments where such mitigation experiments are often conducted. A statistical approach was then taken to quantify the uncertainty in both the discharge and the nutrient data sets due to measurement error estimated by short time-scale variability. These data were then used to assess the impact of the uncertainty on the estimation of nutrient fluxes. The results highlight the importance of acknowledging uncertainty in all data parameters, even when using paired high temporal resolution datasets if an appropriate estimate of the range of potential nutrient fluxes from catchments is to be gained.