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Comparisons of high-frequency nutrient flux data with passive and low frequency alternatives in Irish rivers

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Phosphorus and nitrogen are pervasive contaminants in river systems in developed countries, and eutrophication a major impediment to achieving compliance with regulatory targets for improving the ecological status of fresh water bodies. Gauging the extent to which mitigation measures designed to limit nutrient loss are successful relies on monitoring strategies that capture the variability of the system, both spatially and temporally. Strong hydrological controls on contaminant fluxes, linked to the highly variable maritime climate as well as high runoff rates from impermeable soils, make this a particular challenge in a north-west European context.
Routine, monthly sampling is easily implemented across a large number of catchments, and forms the basis of national monitoring strategies in many countries. It is unlikely, however, to capture the short duration, high flow storm events which can account for most of the annual diffuse loss of N and P. By contrast, near-continuous sampling captures the spectrum of temporal variability in the system using novel automated bankside analysers, down to sub-hourly frequencies, but is feasible only in select research catchments.
Here we evaluate a range of alternative approaches that may provide a compromise between these extremes. Recently flow-integrated passive sampling technologies have been developed, which sequester P and N to an adsorbent in an in-stream cartridge containing a salt block which dissolves in proportion to the volume of throughflow. These samplers were deployed at 5 research catchments in Ireland alongside existing bank-side monitoring stations, and the flow-integrated mean concentrations compared and validated against those recorded at the monitoring stations over the duration. After 14 field deployments, recoveries were reasonable but variable, possibly due to combinations of adsorbent and flux uncertainty in the cartridges at different times. A number of alternative sampling strategies are also evaluated, including focussed sampling of storm events, composite sampling and grab sampling at higher frequencies, obtained by simulated sub-sampling of the near-continuous data sets. These strategies are all based on the use of standard auto-sampling equipment and should be amenable to integration with existing national monitoring strategies.