Monitoring phosphorus loads from headwater grassland catchments in the South West of England

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Despite advances in researchers' capabilities in predicting phosphorus (P) losses, the strength of these models relies on the robustness of the measured hydrological and water quality data. The data collected in the field are commonly used to both parameterise models and evaluate the results; thus, the choice of monitoring strategy is of critical importance if behavioural models are to be identified correctly. Storm events play a key role in transporting particulate and dissolved P but the significance of these fluxes in terms of downstream water quality may be missed by either daily or weekly sampling. This NERC-funded study presents data from three contrasting headwater, farm-scale grassland catchments in the South West of England, which have been sampled at sub-hourly resolutions during 20 storm events during the 2009/2010 hydrological season. The choice of study catchments was determined through GIS analysis of land use and soils in the regions and examination of existing data sets. The data builds on previously collected datasets from Den Brook (a heavy clay, intensively stocked catchment of 48 ha), Drewston (a sandy, improved grassland catchment of 28 ha) and Slapton Woods (the 24 ha brown earth, mixed management Cairncross subcatchment,). Maximum recorded concentrations of P were 53546 µg/l at Den Brook, 464 µg/l at Drewston and 181 µg/l at Slapton. These concentrations demonstrate that grasslands are significant sources of P as the Organisation for Economic Cooperation and Development suggest that eutrophication problems can be triggered by TP concentrations of 35 to 100 µg/l.

There are significant differences in hydrological responses to rainfall between the catchments; however, all sites demonstrate increased levels of P and sediment during the rising limb of the hydrograph. Velocity measurements used to provide an indication of the uncertainty in stage discharge calculations show that uncertainty is greatest at higher rates of discharge; therefore, calculations of loads should reflect this. The loads should also reflect the uncertainty associated with sampling frequency; using a 60 min sampling frequency (instead of 30 mins) would have led to significant over and under-estimations of both soluble and particulate P loads of up to 17%. In all catchments the uncertainty introduced to total P load determination by stage/discharge calculations is greater than that associated with sampling frequency (based on artificial depopulation of datasets). One storm in each catchment was sampled with six replicate samples and two further storms with three, the degree to which the samples vary, and the influence this has on the loads calculated is discussed. This work, which explicitly quantifies uncertainty surrounding p loading of surface waters, has clear implications for the treatment of measured variables during modelling exercises and the interpretation of observed datasets in support of best land management strategies.