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Assessing water quality trends in catchments with contrasting hydrological regimes

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Environmental resources are under increasing pressure to simultaneously achieve social, economic and ecological aims. Increasing demand for food production, for example, has expanded and intensified agricultural systems globally. In turn, greater risks of diffuse pollutant delivery (suspended sediment (SS) and Phosphorus (P)) from land to water due to higher stocking densities, fertilisation rates and soil erodibility has been attributed to deterioration of chemical and ecological quality of aquatic ecosystems. Development of sustainable and resilient management strategies for agro-ecosystems must detect and consider the impact of land use disturbance on water quality over time. However, assessment of multiple monitoring sites over a region is challenged by hydro-climatic fluctuations and the propagation of events through catchments with contrasting hydrological regimes. Simple water quality metrics, for example, flow-weighted pollutant exports have potential to normalise the impact of catchment hydrology and better identify water quality fluctuations due to land use and short-term climate fluctuations. This paper assesses the utility of flow-weighted water quality metrics to evaluate periods and causes of critical pollutant transfer.

Sub-hourly water quality (SS and P) and discharge data were collected from hydrometric monitoring stations at the outlets of five small ($\sim$10 km2) agricultural catchments in Ireland. Catchments possess contrasting land uses (predominantly grassland or arable) and soil drainage (poorly, moderately or well drained) characteristics. Flow-weighted water quality metrics were calculated and evaluated according to fluctuations in source pressure and rainfall.

Flow-weighted water quality metrics successfully identified fluctuations in pollutant export which could be attributed to land use changes through the agricultural calendar, i.e. groundcover fluctuations. In particular, catchments with predominantly poor or moderate soil drainage classes yielded higher flow-weighted SS concentrations as source availability was combined with enhanced transport efficiency of specific pathways. However, discrepancies between monthly rainfall totals and monthly flow-weighted pollutant export are likely due to event scale variability in storm characteristics, lag times and source availability. This methodology was useful to indicate sub-annual water quality trends due to agricultural land use changes in multiple catchments with contrasting hydrological regimes. Consequently, critical periods of pollutant transfer can be targeted to develop sustainable environmental management strategies.