Classification of Mini-catchment typologies for analyzing dominant controls of nutrient dynamic in three Nordic countries

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Selection of non-point nutrient pollution management and mitigation options in catchments requires in-depth understanding of both spatial and temporal controlling aspects on nutrient dynamics for covering a diversity of factors controlling nutrient transfer to surface waters. Such an understanding can be obtained by analyzing the hysteresis behaviors and export regime in concentration-discharge (c-Q) relationships from the monitoring stations in smaller streams. A classification scheme developed by Pohle et al. (2019), including nine different c-Q relationships classes were defined as a combination of export behavior (dilution, neutral, enrichment) and rotational pattern of the hysteresis (clock-wise, no rotation, anti-clockwise). To perform this, the export behavior was assessed based on the theoretical c-Q relationships by checking whether concentrations decrease, increase or do not change with discharge (Mann-Kendall test). The rotational pattern was also determined by comparing concentrations at the rising and the falling limb of the hydrograph (Kruskal-Wallis test). The classification has been applied to a 8 years record (2010-2017) of daily discharge and discrete nutrient concentration data from 88 small streams including forms such as - Nitrate, Organic N, Dissolved Reactive Phosphorus and Particulate P from Denmark, Sweden and Finland. The streams drains catchments with a size ranging from 0.1 km² – 65 km². Additionally similarity in types of c-Q relationships were investigated by multivariate analysis for N and P forms considering effects of land use, climate, soil type and the size of the catchments.

The dilution behavior of the catchment might dominantly be related to arable catchments with low groundwater inputs and with a good direct contact from root zone to the stream (e.g. through tile drains for N) and macropore or surface runoff for P. The constant behavior of the catchments might dominantly be related to dominance of groundwater fed streams in arable or natural catchments and the enrichment behavior might dominantly be found in catchments influenced by point source discharges of nutrients.

This kind of catchments classification can be used for planning of optimal sampling frequencies in monitoring programs, cost-optimal dosing of mitigation options in catchments and inform about expected inertias in catchment responses to management.