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Evaluating the status and trends in water quality using long-term agricultural runoff monitoring data

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Water quality monitoring in agriculture-dominated catchments is essential to quantify nutrient losses caused by a wide range of anthropogenic activities. In Latvia, water sampling and hydrological measurements at most of the research sites were started in 1995. The agricultural runoff monitoring systems consisted of experimental plots (Mellupite), subsurface drainage fields (Berze, Mellupite, Vienziemite), small catchments (Berze, Mellupite, Vienziemite), small and medium size rivers (15 sub-basins of the Berze River and 9 rivers located in the Nitrate Vulnerable Zones). In addition, 21 groundwater monitoring wells were established at 6 research sites to investigate the effects of agricultural activities on groundwater quality. Water samples were collected routinely on a monthly basis and analyzed for nitrate-nitrogen (NO_3-N), ammonium-nitrogen (NH4-N), total nitrogen (TN), orthophosphate-phosphorus (PO4-P), total phosphorus (TP). Continuous hydrological measurements were carried out using hydraulic measurement structures, pressure sensors and data loggers according to local circumstances.
Long-term monitoring data (1995 – 2017) allowed to evaluate the multiple aspects of nutrient losses from agricultural areas at temporal and spatial scales, e.g., nutrient retention processes, qualitative and quantitative status of waterbodies, and trends in nutrient concentrations over a period of time. The analysis of nutrient concentrations obtained at subsequent spatial scales showed that the concentrations of nitrogen decreases when the scale of measurements increases (experimental plot-drainage field-small catchment-river) likely due to nitrogen retention, dilution and transformation processes within the hydrological network. The presented study showed that the concentrations and loads of nitrogen and phosphorus varied widely between the catchments monitored. Furthermore, pronounced variations in nutrient concentrations and loads have been observed seasonally, inter-annually and in long-term. The monitoring results were used as a useful tool to evaluate and predict the impacts of agricultural activities on water quality. These results were also used for the assessment of agri-environmental measures implemented in Latvia under the EU Water Framework Directive and the EU Nitrate Directive.