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The Interaction Between Groundwater Fluctuations and Nitrate Nitrogen Concentrations: case study in Latvia

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Surface water hydrology and hydro-chemical conditions are deeply connected with processes in soil under natural and artificial affections. Combinations of environmental and human impact factors lead to the different effects of aquatic environment. In Latvia, soil particles and chemical substances are particularly affected by shallow groundwater fluctuations and runoff from soil to open streams because of typically humid climate conditions. Latvia is a country in Baltic Sea region where the pollution with plant nutrients is actual problem. As a negative effect of plant nutrient leaching from soil provoke eutrophication in open streams and water reservoirs and cause increased expenses for farmers to establish nutrient balance within the farm. Decrease of shallow groundwater quality endangers drinking water resources in Latvia. To identify reasons of nitrate nitrogen (NO_3-N) leaching it's necessary to understand the interactions of natural hydrological processes and NO_3-N mobility, as well as artificial influences as leaching with runoff formed by drainage systems and doses of used fertilisers. Most of the agricultural lands is drained because of humid climate conditions. It's significant to estimate the runoff from surface water objects and subsurface drainage, groundwater fluctuations as well as the quality of all the mentioned kind of water source. For the better understanding it's important to get knowledge's of principles of runoff formation and water quality fluctuations and interactions between both of them. For identifying interactions significant data are monitored runoff and water quality measurements in different scale: small catchment, drainage field, groundwater wells as well as trial plots. Research field is based on observed data (2006-2010 year period): measured groundwater level, NO_3-N concentration and drainage runoff. Study area is monitoring object Mellupīte (monitored by Latvia University of Agriculture) small catchment with groundwater well MG-1 and drainage field. Investigation reflects shallow groundwater fluctuations and interactions with NO_3-N concentrations under different intensity of drainage runoff. Three groups of groundwater levels are divided depending on changes of drainage runoff intensity. The groups with groundwater depth (GWD) are:
1. deep groundwater and drainage runoff starting period (GWD= deeper than 140 cm);
2. transition period (GWD= 140...90 cm);
3. intensive runoff period (GWD= shallower than 90 cm) .
Average NO_3-N concentration is lowest in the 1. group (average GWD=1 mg L-1), in the 2. group average GWD=3.2 mg L-1 (320 % more than in the 1. group) and in the 3. group average GWD is highest (6 mg L-1 or 600 % more than in the 1. group). It's concluded that NO_3-N concentration isn't completely dependent on groundwater level. However the trend is similar – concentration could be expected higher in case of groundwater group described as more shallow. On the one hand the main NO_3-N concentration is caused by subsurface drainage runoff, but on the other hand the NO_3-N variability could be affected by differences of NO_3-N amount in various soil depths.
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