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Factors affecting groundwater pollution by nitrate in a sandy aquifer

S. Mattern (1) and M. Vanclooster (2)

Université catholique de Louvain, Department of Environmental sciences an Land use planning, Belgium ((1) samuel.mattern@uclouvain.be, (2) marnik.vanclooster@uclouvain.be)

The high concentrations of nitrate in groundwater are a serious pressure on the Brusselian sandy aquifer located in the centre of Belgium. In order to control and manage groundwater quality, the identification of factors affecting the nitrate concentration of groundwater is of primary importance.
In this study, results of a nitrate monitoring programme and different land and land use attributes were processed by multivariate statistical techniques in order to assess the impact of various explanatory variables on groundwater quality. The nitrate dataset encompasses 10,309 groundwater samples collected in 109 wells between January 1995 and June 2006. Since the sampling rate and the spatial repartition of the monitoring stations are not homogeneous, we had to ensure the independence of the data by space-time declustering. Each well capture zone has been delineated by taking into account the piezometric levels, the groundwater flow directions, the surface topography, the unsaturated zone geology and the hydrographical network. Based on the vertical infiltration velocity of water in the unsaturated zone and its horizontal velocity into the groundwater body, we limited the extent of the well capture zones so as to only take into account the nitrate contamination that could have reached recently the monitoring stations. The explanatory variables that were tested are land use, depth to groundwater table, altitude, slope, population density, soil organic matter content, soil type and some water quality parameters (e.g. dissolved oxygen, pH, Cl^-).
Since it is expected that nitrate pressure is inversely proportional to water table depth, the data were weighted by giving more importance to those where the water table was near the surface and less importance to those where the unsaturated zone was thick.

After normalisation, the variables were combined into a multiple regression model. As a conclusion, we propose a sorted list of the variables that significantly affect the groundwater pollution by nitrate. Preliminary results tend to show that the habitat and services land use class has the most explanatory power.