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Estimation of the Impacts on the Quality of Groundwater Bodies in Slovenia

J. Prestor, M. Janza, J. Sinigoj

Geological Survey of Slovenia, Slovenia (mitja.janza@geo-zs.si / Phone: +386 1 2809 794)

In the contribution a methodology for estimation of the impacts on the quality of groundwater from disperse sources of nitrogen is presented. The methodology considers agricultural and urban areas sources of nitrogen. A nitrogen input amount is calculated as a sum of products of landuse unit area and its expected nitrogen surplus. These values are divided with infiltrated amount of water in order to estimate nitrogen concentration in the yearly renewable groundwater volume. Infiltration is a part of precipitation that remains from precipitation after evapotranspiration and surface runoff is subtracted. The evapotranspiration was estimated with Turc's formula, where the distribution of average yearly precipitation and temperature for the period from 1961 to 1990 were used. The amount of surface runoff was calculated as a product of effective precipitation (difference between precipitation and evapotranspiration) and surface runoff coefficient that was derived with Kennessy methodology, using slope, land cover and lithostratigraphical maps.

Estimated concentrations of nitrogen are in the next step corrected according to the expected natural retardation capacity of the aquifers. Reduction factors range from 0.1 to 1 depending on the aquifer vulnerability. The assessment of vulnerability is based on the estimated groundwater velocity. Darcian groundwater velocity is product of hydraulic conductivity and hydraulic gradient. The hydraulic conductivity depends on rock properties – their ability to conduct fluids. The values of conductivity (their ranges) for each lithostratigraphical unit were defined on the basis of available measurements and hydrogeological interpretation. Assumption that the groundwater table depends on the inclination of the surface was used for the estimation of hydraulic gradient. Its estimation is based on the slope map - derivative of digital elevation model of Slovenia with the grid size 25 m. The hydraulic gradient map is smoothed slope map with the 40 x 40 mean filter.

In the final step corrected (modeled) nitrate concentrations are compared with the measured values. A relation (measured concentration = 6.3458 + 0.4439 * modeled concentration) with correlation factor is established (R^2 = 0,6858). The relation enables estimation of expected nitrogen content in the aquifers where no monitoring wells exist, which gives an ability to estimate regional impacts on the quality of groundwater in aquifers in Slovenia and to use this results as one of the criteria for characterization of groundwater bodies.