Geophysical Research Abstracts
Vol. 19, EGU2017-15158, 2017
EGU General Assembly 2017

Lagtime of river systems to changes in pollutant load on the catchment: a regional scale assessment

Anna J. Żurek (1), Kazimierz Różański (2), and Stanisław Witczak (1)

(1) AGH University of Science and Technology, Faculty of Geology, Geophysics and Environmental Protection, Krakow, Poland (zurek@agh.edu.pl), (2) AGH University of Science and Technology, Faculty of Physics and Applied Computer Science, Krakow, Poland (rozanski@agh.edu.pl)

Transport of conservative contaminants through groundwater systems (e.g. nitrate under oxidized conditions) is significantly delayed when compared to movement of those contaminants through surface water compartments. Characteristic time scales of groundwater movement may easily reach tens or hundreds of years. This results in large lagtimes of contaminant transport in the subsurface. These lagtimes are particularly important when response of river basins to measures aimed at recovery of good groundwater status is considered. Incorporating lagtime principles into water quality regulations may result in more realistic expectations when such policies are designed and implemented. The lagtime of contaminant transport in the subsurface with respect to transport through surface and near-surface (drainage) runoff can be separated into two components: (i) the delay associated with travel time of water (and contaminants) through the unsaturated zone, and (ii) the delay linked to time scales of groundwater flow, from the recharge area down to the discharge zone (river). Thus, the travel time of water through unsaturated and saturated zones can be considered a quantitative measure of the lagtime.
Lagtime in the unsaturated zone on the territory of Poland was assessed on the basis of the existing Groundwater Vulnerability Map of Poland (GVMP) (Witczak et al., 2007; 2011). The adopted approach relies on MRT (Mean Residence Time) of water in the strata separating the saturated aquifer from the land surface, as an integrated vulnerability index. In the framework of GVMP, the MRT is calculated as turnover time of the infiltrating water in the vadose zone. The piston-flow type of water movement through the unsaturated zone is considered. The lagtime in the saturated zone (Tsat) can be approximated by travel time of water, flowing along the local hydraulic gradient to the closest river. The lagtime of river systems with respect to changes in pollutant load on the catchment is a sum of the travel time of water through the unsaturated zone (MRT) and the travel time associated with movement of water in the saturated zone (Tsat). Preliminary assessments of total lagtime (MRT + Tsat) suggest that for the territory of Poland the mean value of the total lagtime of conservative contaminant is in the order of 25 years, with the range of 10 to 60 years corresponding to one standard deviation.

References:
Witczak S. (Ed.) (2011). Groundwater Vulnerability Map of Poland. Ministerstwo Środowiska. Warszawa.
Witczak S., Duda R., Zurek A. (2007). The Polish concept of groundwater vulnerability mapping. [In:] Witkowski A.J., Kowalczyk A., Vrba J., Groundwater Vulnerability Assessment and Mapping, Selected Papers on Hydrogeology 11, 45-59.

Acknowledgements. The work was carried out as part of the project BONUS Soils2Sea and the statutory funds of the AGH University of Science and Technology (projects No.11.11.140.797 and 11.11.220.01).