Geophysical Research Abstracts
Vol. 18, EGU2016-11413, 2016
EGU General Assembly 2016

Groundwater transit time distribution and transfer of nitrates from soils to river network

Tomasz Michalczyk (1), Dominika Bar-Michalczyk (1), Marek Duliński (2), Jarosław Kania (1), Grzegorz Malina (1), Kazimierz Różański (2), Tadeusz Szklarczyk (1), Przemysław Wachniew (2), Stanisław Witczak (1), Damian Zięba (1), and Anna Żurek (1)

(1) AGH University of Science and Technology, Faculty of Geology, Geophysics and Environmental Protection, al. Mickiewicza 30, PL30059 Kraków, Poland (tmmichalczyk@gmail.com), (2) AGH University of Science and Technology, Faculty of Physics and Applied Computer Science, al. Mickiewicza 30, PL30059 Krakow, Poland

Measures undertaken to reduce nitrate loadings of agricultural origin to surface waters have to take into account delays associated with pollution transport between the root zone and groundwater abstraction wells or natural discharge zones. Parts of an important fissured-carbonate aquifer (Major Groundwater Basin No. 326) located in southern Poland are polluted, with concentrations of nitrates significantly exceeding the European Union limit of 50 mg/L. The polluted groundwater discharges to the streams of the Kocinka river catchment affecting their water quality.

The MODFLOW and MT3DMS codes were used to model flow and transport of contaminants in the aquifer. Transport of conservative solutes was performed in a transient mode, with the steady-state flow field calibrated using present-day distribution of hydraulic heads and discharges of streams draining the aquifer. Time series of tritium data available for 21 production wells and springs, some of them extending over the period of 30 years, were used for calibration of flow and transport model resulting in significant changes in the original conceptual framework of this groundwater system. The regional-scale numerical model of flow and transport allowed for identification of the gaining stream reaches and for estimation of groundwater contributions to streamflow. Observations of in stable isotope composition and stream water chemistry confirmed the results of the numerical model for these particular stream reaches. The numerical model provided also the transit time distribution of groundwater flow through the saturated zone with an average value of 8 years and dominant transit times in the range from 3 to 20 years. Transit times of water through the unsaturated zone are in the range from less than 5 to 25 years with an average value of 10 years. Because of these delays, the results of measures aimed at reducing nitrate loads to the river network will be visible only within the relevant timescales.