Geophysical Research Abstracts
Vol. 18, EGU2016-10610-1, 2016
EGU General Assembly 2016

Evolution of Unsteady Groundwater Flow Systems

Xing Liang (1), Menggui Jin (1,2), and Hong Niu (1)

(1) School of Environmental Studies, China University of Geosciences, Wuhan, 430074, China (xliang@cug.edu.cn), (2) State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences, Wuhan 430074, China (mgjin@cug.edu.cn)

Natural groundwater flow is usually transient, especially in long time scale. A theoretical approach on unsteady groundwater flow systems was adopted to highlight some of the knowledge gaps in the evolution of groundwater flow systems. The specific consideration was focused on evolution of groundwater flow systems from unsteady to steady under natural and mining conditions. Two analytical solutions were developed, using segregation variable method to calculate the hydraulic head under steady and unsteady flow conditions. The impact of anisotropy ratio, hydraulic conductivity (K) and specific yield (μ_s) on the flow patterns were analyzed. The results showed that the area of the equal velocity region increased and the penetrating depth of the flow system decreased while the anisotropy ratio ($\varepsilon = \sqrt{K_x/K_z}$) increased. Stagnant zones were found in the flow field where the directions of streamlines were opposite. These stagnant zones moved up when the horizontal hydraulic conductivity increased. The results of the study on transient flow indicated a positive impact on hydraulic head with an increase of hydraulic conductivity, while a negative effect on hydraulic head was observed when the specific yield was enhanced. An unsteady numerical model of groundwater flow systems with annual periodic recharge was developed using MODFLOW. It was observed that the transient groundwater flow patterns were different from that developed in the steady flow under the same recharge intensity. The water table fluctuated when the recharge intensity altered. The monitoring of hydraulic head and concentration migration revealed that the unsteady recharge affected the shallow local flow system more than the deep regional flow system. The groundwater flow systems fluctuated with the action of one or more pumping wells. The comparison of steady and unsteady groundwater flow observation indicated that the unsteady flow patterns cannot be simulated by the steady model when the condition changes frequently.

This study was financially supported by National Natural Science Foundation of China (U1403282 & 41272258).