A General Solution for Groundwater Flow in Estuarine Leaky Aquifer System with Considering Aquifer Anisotropy

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In recent years the urban and industrial developments near the coastal area are rapid and therefore the associated population grows dramatically. More and more water demand for human activities, agriculture irrigation, and aquaculture relies on heavy pumping in coastal area. The decline of groundwater table may result in the problems of seawater intrusion and/or land subsidence. Since the 1950s, numerous studies focused on the effect of tidal fluctuation on the groundwater flow in the coastal area. Many studies concentrated on the developments of one-dimensional (1D) and two-dimensional (2D) analytical solutions describing the tide-induced head fluctuations. For example, Jacob (1950) derived an analytical solution of 1D groundwater flow in a confined aquifer with a boundary condition subject to sinusoidal oscillation. Jiao and Tang (1999) derived a 1D analytical solution of a leaky confined aquifer by considered a constant groundwater head in the overlying unconfined aquifer. Jeng et al. (2002) studied the tidal propagation in a coupled unconfined and confined costal aquifer system. Sun (1997) presented a 2D solution for groundwater response to tidal loading in an estuary. Tang and Jiao (2001) derived a 2D analytical solution in a leaky confined aquifer system near open tidal water. This study aims at developing a general analytical solution describing the head fluctuations in a 2D estuarine aquifer system consisted of an unconfined aquifer, a confined aquifer, and an aquitard between them. Both the confined and unconfined aquifers are considered to be anisotropic. The predicted head fluctuations from this solution will compare with the simulation results from the MODFLOW program. In addition, the solutions mentioned above will be shown to be special cases of the present solution. Some hypothetical cases regarding the head fluctuation in costal aquifers will be made to investigate the dynamic effects of water table fluctuation, hydrogeological conditions, and characteristics of soil on the groundwater level fluctuations in the 2D estuarine leaky aquifer system.