Geophysical Research Abstracts
Vol. 14, EGU2012-5723-1, 2012
EGU General Assembly 2012

Aquifer-scale fluxes, hydraulic heads, and upscaled hydraulic conductivities: behaviour during transient flows

G.H. de Rooij
Helmholtz-Zentrum fuer Umweltforschung - UFZ, Department Bodenphysik, Halle (Saale), Germany (gerrit.derooij@ufz.de)

Catchment- or basin-scale hydrometeorological models can benefit from groundwater flow models that are able to handle large-scale parameters, yet preserve as much as possible of the Darcian-scale understanding of groundwater flow. At large scales the interest is mainly in exchanges of water between environmental compartments, e.g., the flux Q ($\mathrm{L}^3\mathrm{T}^{-1}$) between groundwater and surface water. Maps of hydraulic heads will generally neither be generated by such models, nor be required as input. Instead, spatial averages of such heads may be more useful.

Therefore, the relationship between Q and the difference between the average hydraulic head and the surface water level ($\overline{H} - H_A$) was determined from analytical solutions for transient parallel and radial flows obeying the Dupuit assumptions. For constant forcings, the solutions showed that Q will eventually be proportional to ($\overline{H} - H_A$) (relaxed state), with three different proportionality constants for non-leaky aquifers (for zero and non-zero recharge) and leaky aquifers. The proportionality constants incorporated the effects of the forcings, porous medium properties, and aquifer geometry. Thus, under favourable conditions, the Darcian proportionality between the flux density and the gradient in the hydraulic head is echoed at the aquifer scale by the proportionality between the flux across the groundwater-surface water interface and the difference between the average hydraulic heads of both bodies of water. The resulting proportionality constants can be viewed as upscaled hydraulic conductivities. For conductive aquifers intersected by dense drainage networks, the upscaled hydraulic conductivity will reach its asymptotic value within days after a perturbation in the forcings, while large systems will normally never reach a relaxed state and the full solutions will be required.