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Effects of Vertical Clogging Layer on the Surface-Groundwater Interaction in Unconfined Sloping Aquifer

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This study presents an analytical model to understand the dynamic behaviour of surface-groundwater interaction in a stream-aquifer system in the presence of a clogging layer. The mathematical model consists of an unconfined aquifer of semi-infinite extent resting on a sloping impervious base and interacting with a stream of varying water level. The hydro-interaction is mediated by a thin clogging layer whose hydrologic properties are different from that of the aquifer. The unsteady groundwater flow is approximated by linearized advection-diffusion equation subjected to mixed boundary conditions, including a nonlinear Robin boundary condition. Closed from analytical expressions are developed for water head distribution, flow rate and volumetric exchange of water between stream and aquifer. In few limiting cases, the results reduced to earlier known results. Performance of analytical solution is compared with numerical solution of corresponding nonlinear Boussinesq equation. Sensitivity of the aquifer parameters is analyzed with an illustrative example.

Keywords: Stream-aquifer interaction; Clogging Layer; Sloping aquifer; Boussinesq equation; Robin boundary condition; Laplace transform

Biography:

Chhaya Kiran Lande is a Research scholar of Symbiosis International (Deemed University), Pune, India and working as an Associate professor In mathematics at the RMD Sinhgad school of Engineering, Pune. She has obtained her M.Sc. in Mathematics from North Maharashtra University, Jalgaon, India. Her area of research is surface-groundwater hydrology. Her area of interest is differential equations, Hydrology, Numerical methods, Transforms. She has published various papers in peer reviewed journals. She developed Mathematical models which has capable of predicting water table fluctuation in confined and unconfined aquifer by considering complex geological system for her Ph.D.