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Optimal Control of Groundwater Pollution Combined with Source Abatement Costs and Taxes

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Abstract In this paper, we develop a new groundwater pollution control by finding the optimal amounts of fluxes for disposals, where the optimization objective function is proposed by considering the overall effects caused by pollution, abatement costs and pollution taxes. The proposed optimal control model is subject to the flow and transport groundwater equations in porous media. More specifically, we use the splitting scheme and the second-order improved-upwind method to simulate the flow and transport processes in the groundwater system in porous media. We then integrate the simulated results with an optimization problem which minimizes the pollutant concentration deviation, abatement cost and pollution tax simultaneously. The optimization problem is solved by the constrained difference evolution (DE) optimization algorithm. The performance of the proposed optimal control model is evaluated on two synthetic simulations: one on an aquifer with a simple geometry and with constant disposal fluxes, and the other on a more realistic-shaped aquifer with fluxes varying piecewise in time. The developed source optimal control model and its algorithm can be applied to large scale applications of groundwater pollution control on aquifers.

Keywords: Groundwater pollution; optimal control, splitting finite difference; improved-upwind; difference evolution.

1. Introduction

The contamination of groundwater is a very common problem encountered recently over the world wide, since it has posed a serious threat to the environment and social development.

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