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EMPLOYING EVOLUTIONARY ALGORITHMS FOR OPTIMIZING FREE PHASE LNAPL RECOVERY

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Summary. In recent years, researchers have focused their efforts on designing algorithms that couple simulation models with optimization techniques in order to improve the time-efficiency and cost-effectiveness of groundwater remediation strategies. While many models focused on optimizing pump and treat designs, very few attempted to optimize free product recovery of light non-aqueous phase liquids (LNAPLs).

The work presented in this paper combines FEHM (Finite Element Heat and Mass transfer code), a model developed by the Los Alamos National Laboratory that can simulate LNAPL transport in the subsurface, with two evolutionary algorithms: the genetic algorithm (GA) and the differential evolution (DE) algorithm. A non-linear, multi-objective optimization problem is designed that combines two objectives: the first is associated with the economical aspect of the problem, in this case the pumping wells operation cost, and the second involves the environmental considerations represented by the maximization of free product removal or equivalently the minimization of the LNAPL free phase product that remains in the aquifer after the end of the remediation period.

The proposed optimal free phase recovery algorithm is tested using data from a field site contaminated with LNAPLs, located near Athens, Greece. The results obtained using the two optimization algorithms are very similar concerning the pumping rates, the optimal objective function values and the computation time needed to perform the same number of algorithm iterations. However, the genetic algorithm converges to a slightly smaller objective value while the DE converges to a nearly optimal solution much faster than the GA.