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Coupling of Richards' equation and surface water models

The talk concentrates on the numerical simulation of saturated-unsaturated groundwater flow and its coupling with surface water models.

First we introduce a new approach for the solution of the Richards equation in heterogeneous soil which completely avoids linearization. In contrast, it is based on convex minimization, which is carried out after applying Kirchhoff's transformation separately in subdomains with homogeneous soil, and nonoverlapping domain decomposition techniques, which exploit continuity of the pressure and the water flux across the interfaces between the subdomains.

Mass conservation and continuity of the hydrostatic pressure as well as heterogeneous domain decomposition methods also come into play for the coupling of Richards' equation and surface water models. In case of a reservoir with non-moving surface water our solver for the Richards equation also determines the extend of the seepage face around the lake which is given by Signorini-type conditions. Finally, we introduce a solver of Dirichlet–Neumann type for the coupling of the Richards equation with the depth-integrated shallow water equations. Several numerical examples illustrate the applicability of our methods.

The presented material is based on joint work with Ralf Kornhuber and Oliver Sander.