Geophysical Research Abstracts, Vol. 9, 06030, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06030

New 2D benchmark experiment for the density-dependent saltpool problem

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Existent flow tank experiments of stably layered saltwater below freshwater in a homogenous system, affected by discharge of water at the top, have shown that the simulation of the problem with numerical models is less reliable for high concentration differences than for low ones. Therefore, in order to evaluate the models, more detailed experiments are necessary. In this study we present a two dimensional experiment of the saltpool problem with brine concentration of 100 g/l, where a forced flow in a 1.70 x 0.70 x 0.04 m^3 Plexiglas tank causes a density difference dependent upconing of saltwater below a well. Measured inflow and outflow flux and hydraulic heads at the inflow and outflow of the tank provide an exact description of the boundary conditions. Image analysis is applied for visualization and quantification of the concentration distribution within the flow tank using a dye tracer. This enables the determination of time dependent salt concentration curves at each point of the tank and the determination of the spatial concentration distribution. A newly developed conductivity measurement system offers in-situ point measurements of salt concentration at different locations within the porous media. Supplementary experiments with horizontal flow of a lower concentrated (no density effects) chloride tracer were conducted to determine experimental parameters of dispersivity and permeability within the flow tank. Numerical simulations with the variable-density flow code TVDV-2D were performed and compared with the experimental data.