Hydrological and Groundwater Flow Modelling

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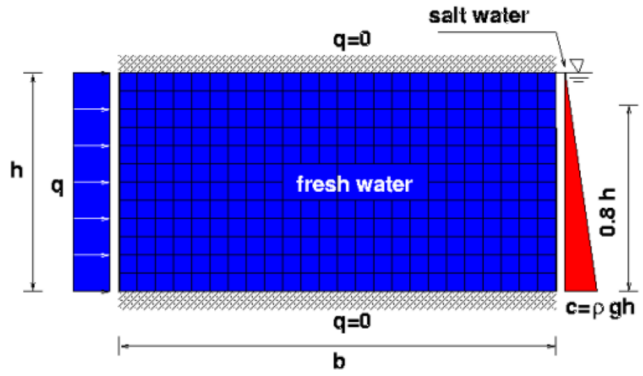
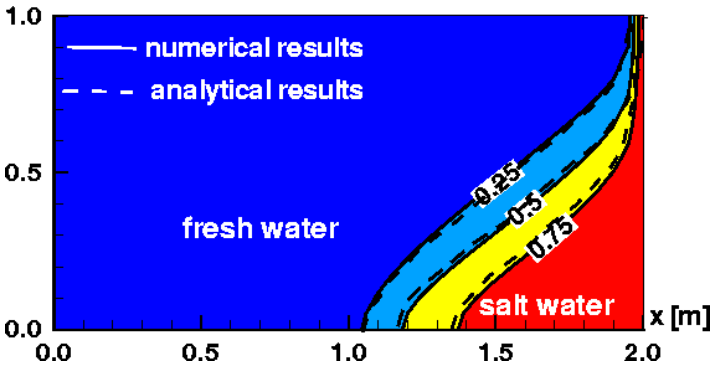
Within the groundwater modelling group, we are developing a **0-dimensional model** for the large scale **water balances** for a part of the Eckernfoerder Bay which gives the input for a regional scale model that is developed by other partners.

Based on this we carry out small scale **2- and 3-dimensional simulations**. We started our work with some principal case studies concerning boundary conditions for groundwater systems. The question was, who must the boundary conditions look like that seeps can occur. Then a comparison of different model concepts for salt water intrusion processes has been carried out using the well-known Henry problem.

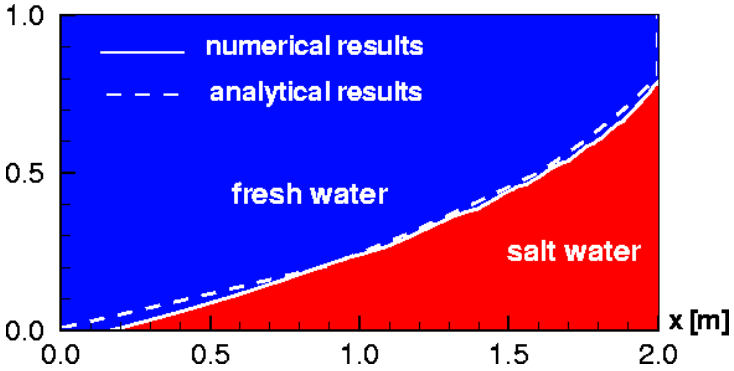


In the figure above, the **mesh and the boundary conditions for the Henry problem** are shown. Initially, the system is filled with fresh water. On the left boundary fresh water influx is prescribed, on the right boundary a hydrostatic pressure distribution.

The two phase flow concept assumes that fresh and salt water are different phases which are not soluble in each other, and consequently, these two liquids are seperated by a sharp interface. The single phase / two component concept takes into account that fresh and salt water are miscible. **Thus a mixing zone occurs**, where the salinity gradually changes due to hydrodynamic dispersion.



Single Phase / Two-Component Model Concept



Two-Phase Flow Model Concept

ANIMATED GIF

As shown in the figures above, a salt water tongue is moving into the system reaching a steady state solution later. A reasonable agreement between the numerical and analytical results was obtained for both model concepts. For our purpose, we found out that the single-phase / two-component approach should be prefered. Future simulations will deal with gas (methane) / water flow and multiphase / multicomponent flow (phases: fresh water, salt water, gas, components: fresh water, salt, water, methane, nutrients ...). In addition, our small scale models will be nested in the regional scale model using geological and physical parameters of other partners.

Further informations at: http://www.geomar.de/projekte/Sub-GATE