Course: GW Flow and Contaminant Transport Modeling

Homework #2: Simulation of unit basin problems – Steady state simulation of flow in a vertical profile

Hydrogeological problem

The continuity approach of hydrogeological regimes was firstly published by Joe Toth (1963). He assumed a „Unit Basin" defined as a vertical 2D problem: a slope with no flow boundary at the sides and the bottom and a linearly decreasing potential at the top.

Build a Unit Basin model (Case 0). Hydrogeological conditions of the base model: The simulated system consists of a silty, silty sand aquifer (the parameters can be freely chosen). There are no flow boundaries at all sides. The potential distribution on the top surface is linearly decreasing, the horizontal hydraulic gradient is constant (please apply freely chosen a horizontal hydraulic gradient in the range of 1-3 m/km).

Further cases to be investigated:
Case 1a&1b: Modify hydraulic conductivities by 10 and 0.1 times (±1 order of magnitude).
Case 2: Apply an anisotropy of K_h/K_v=20.
Case 3: Modify the homogeneous flow field to layered system of silty and sandy layers (split the model domain to 5 horizontal layers with alternating silt and sand properties (to be freely chosen) .
Case 4: Modify the top boundary conditions (3-5 total waves: same average horizontal hydraulic gradient as in Case0 with amplitude of 0.4 m).

Tasks to be performed at each investigated case (from Case 0 to Case 4)

- Calculation of the flow field (potential distribution)
- Saving the head matrices
- Plotting pathlines starting from the surface at constant distance intervals
- Saving pathline plots to dxf or bmp files
- Determination of the potential changes compared to Case 0 (from Case 1 to Case 4) by either making head distribution differences (h_{Case0}-h_{Casex}) or head distribution ratio (h_{Case0}/h_{Casex}). To do it use the saved matrices in an unused part of the modeling environment load the Case0 matrix with replacement and load the other matrix with subtract or divide option! Draw a contour map (distribution) of the difference or the ratio and save it & plot it!

Materials to be presented:

In printed form a short report of the problem with
- the description of the models
- the details of the chosen data sets
- graphic presentation of the mentioned potential fields or drawdown distributions
- graphic presentation of pathlines at different scenarios
- the evaluation of results (head differences or head ratios)

Digitally (only at the end of semester)
- report in document form
- total dataset
- plots in graphical form