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Subsurface Fluid Flow Module–Mini-project Suggestions

Project 1

Using the code you developed for Homework 2, solve the following problems.

1. Farmer Ben buys a tract of land adjacent to Farmer Ted's. Farmer Ted has an existing well that pump's at a rate of 2000 m/day. Farmer Ben needs to pump at the same daily rate. Where can he place his well given the following constraints (list all possible locations)?

   (a) The well must be on his portion of land; Ben owns columns 16-30.

   (b) The aquifer only reaches a depth of 390.

   (c) Farmer Ted acquires desired amount of water per day.

   (d) The constant head boundaries are both rivers; realistically wells can not be drilled within one cell of the boundary because of the likelihood of a well collapse.

2. Farmer Ben's contractor dug a well at location (row 8, column 23) without Ben's knowledge. What's the maximum amount Ben can pump from that well?

3. What if the dataset is too large for guess and check how could you have the computer do the work for you in problems 1 and 2 (write the code)?

Project 2

1. Add to the code you developed for Homework 2 by allowing it to work for the transient case.

2. Add to the transient code by developing code that turns wells on and off at different times.

3. Given two pre-existing wells, both pumping at rate of 2000 m/day can you schedule them so that you don't hit the bottom of the aquifer (390m).

Project 3

Using the two-dimensional Advection-Dispersion equation, with the assumption that advective transport is only relevant in the x-direction,

$$\left[\frac{\partial}{\partial x}\left(D_x\frac{\partial C}{\partial x}\right)+\frac{\partial}{\partial y}\left(D_y\frac{\partial C}{\partial y}\right)\right]-\frac{\partial}{\partial x}\left(v_x C\right)=\frac{\partial C}{\partial t}$$

write MATLAB code that determines the contaminant concentration level at any given time for each cell of the given domain.