ENVE 681 – HW 5
This is a two-part homework, with components due 11/17/17 and 11/27/17

Due: 11/17/17

1- TRANSIENT 1D PROBLEM

Consider the 1D Boussinesq equation you derived (and solved analytically) last week describing the falling water table profile between two stationary creeks separated by a distance of 400m in an aquifer with a depth of 4m, Ks = 5 m/day, and Sy=0.8. Assume that the hydraulic head, h, in both boundary creeks is 0.

a) Write an explicit (FD/CD) solution to approximate the change in water table over time
b) Write a Crank-Nicholson/central difference (CN/CD) solution

$$\frac{\partial h}{\partial t} = \frac{T}{S_y}\frac{\partial^2 h}{\partial x^2}$$

2- TRANSIENT 2D (ISLAND) PROBLEM

Using your solution to the steady-state island recharge problem from Homework 3 (without the inlet and with R = 40 cm/year) as an initial condition, write a code to describe the falling ground water table as a function of time when recharge ceases over the island (ie R goes to 0). Assume T = 200 m^2/day and S_y = 0.8. The boundaries (600m x 1000m) and boundary conditions (h=10m surrounding all edges) remain the same. Use a Crank-Nicholson / central difference modeling scheme.

$$\frac{\partial h}{\partial t} = \frac{T}{S_y}\left(\frac{\partial^2 h}{\partial x^2} + \frac{\partial^2 h}{\partial y^2}\right)$$

Due 11/27/17:

1- TRANSIENT 1D PROBLEM

a) Demonstrate (through plots) the stability of the two solution methods at different values of Δt
b) Compare the analytical solution to your numerical approximation. Calculate the infinity norm
c) Using the infinity norm over a range of Δx values, determine the order of accuracy of the CN/CD scheme with respect to Δx

2- TRANSIENT 2D (ISLAND) PROBLEM

a) At what time (in days) does the maximum change in hydraulic head on the island reach less than 10^-5 m/day
b) Try adjusting the transmissivity, T, of the aquifer so that it is non-uniform. Randomly vary the T at each node within a range of 50-250 m^2/day. How does your solution compare to an aquifer with uniform T?