TD 603- Tutorial 4

1. Use `simulate2017.sci` to simulate a well with discharge 0.1 mm in the 11th cell in a domain of 41 cells. Keep other parameters as in the program. Use the starting heads as 60m.

   - Simulate this in multiples of 100 days and plot the heads. At the end of 100 days, what are the flows from cell (I) to cell (i+1) in cubic meters per day? Does that match with the change in heads on the 101-st day?
   - Guess what should be the steady state and put that in as the starting heads. How many days need to elapse for the steady state to approximately arise?
   - Modify the code to drop the thick aquifer assumption and start the shallow-aquifer assumption to compute flows. Start this system with the steady state above and observe deltah. What can you say about the steady state under this new way of computing flows?

2. Do 1(b) above, but by changing the halving the parameters l,W and K and thickness, one at a time. What is expected and what is observed?

3. Modify simulate2017 to input K, the conductivity, as a vector, instead of as a fixed input. Use K(i) to compute the flows into cell I. Now do problem 1(b) where the conductivity of cell 21 is changed to 0.1 and then 0.01 while other cells are kept at 1. Narrate what happens.

   What happens if the conductivity of all cells 21 and beyond is changed to 0.1 and 0.01?

4. Consider a small regional watershed as shown below. There are two rain-guages RG1 and RG2, four observation wells OB1-OB4 and a V-notch at the exit of the watershed. The rain-gauges give us daily rainfall readings, while the observation wells are read monthly. The V-notch gives us weekly discharge in cu.m./week.

   There are three types of land-use, viz., wasteland, only *kharif*, which begins in June and and ends in October, *kharif+rabbi*, which ends in January. *Kharif* requires an ET load of about 320mm, while *rabbi* requires 400mm. Soil holds a maximum of 50mm.

   The well locations are as follows:

Well	Elevation	Aquifer Thickness	S_y	K (in m/day)
OB1	275m	20m	0.05	1.1
OB2	285m	15m	0.03	1.1
OB3	265m	20m	0.05	2.1
OB4	250m	30m	0.12	3.5

   Observations at wells and rain-gauges are as follows:

Source	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
OB1 (m.bgl)	5	7	8	10	12	10	8	5	3	4	4	5
OB2 (m.bgl)	6	7	8	9	10	9	5	3	2	3	4	5
OB3 (m.bgl)	5	6	9	11	10	8	6	2	2	3	4	5
OB4 (m.bgl)	5	6	7	8	9	7	4	3	3	4	4	5
RG1 (mm)	0	0	0	0	40	160	190	140	100	30	0	0
RG2 (mm)	0	0	0	0	30	150	180	160	100	20	0	0

   (a) Estimate the amount of groundwater stored in the region as a function of time.

   (b) Based on this and the rainfall, estimate the amount of water which is discharged out of the watershed.

   (c) Estimate the total water requirement. Is the cropping pattern sustainable based purely on groundwater?

   (d) Estimate the groundwater flow from the upper to the middle reaches and from the middle to the lower reaches.

(e) Plot an estimate of the V-notch flow data. Suggest locations of additional flow meters and conjecture the flows at that time.

(f) There is a plan to make some reservoirs in the watershed to augment the water in the system. What amount of water do you think should be stored and where do you think the reservoirs should be located? Do the flow-meter readings matter in the design of the reservoirs?