Hydrus 1D exercise – Irrigation and Rainfall Infiltration

Describe the dynamics of rain infiltration. Evaluate amount of infiltrated water, find out whether surface runoff appears and if does, determine time when does it occur and its amount.

Problem description:

Corn field, situated in gentle slope, is daily irrigated. Quite shortly after scheduled irrigation, short heavy precipitation event occurred. Such an event may cause soil erosion and transport of fine soil particles with traces of fertilizers into nearby stream.

Tensometric data before irrigation:

Surface level … -400 cm
Depth of 100 cm … -300 cm

Irrigation schedule:

Start of irrigation … 7:00
End of irrigation … 8:30
Irrigation intensity … 10 mm/h

Precipitation event:

Start … 9:00
Duration … 15 min
Intensity … 30 mm/h

Beware of units!!!

Potential evapotranspiration … 6 mm/d
Root zone depth … 45 cm

Simulation:

Soil profile is 100 cm deep and consists of 2 different horizons. Hydraulic characteristics of both layers were experimentally determined (see table). For simplicity we assume no evapotranspiration.

Horizon	Depth (cm)	Th_r	Th_s	Alpha (1/cm)	n	Ks (**cm/d**)
A	0 – 35	0.1	0.40	0.012	1. 5	24
B	35 - 100	0.07	0.34	0.003	1.21	18

Plot the inflow rate and cumulative infiltration into soil profile. Compare the plots with the irrigation and rainfall amounts. To be able to describe infiltration process properly, choose appropriate observation points and print times. Determine the depth of water front immediately after rainfall. For chosen times (select the print times yourself) show moisture as a function of depth.

Questions:

(To answer all the questions, you will have to run the model several times.)

1/ Does surface runoff appear?
2/ How much water was infiltrated and how much water flowed off by surface runoff?
3/ Assume no irrigation. Does surface runoff still occur?
4/ Does the rainfall significantly affect soil profile water regime below root zone (cca -40 cm)?
5/ Increase the rain intensity to 100 mm/h. Assume the field is in flat area and no surface runoff appears, thus ponding occurs during precipitation. When does all water infiltrate? What is the maximal depth of ponding and when does it occur? (you will need to change the scale on y-axis)
6/ Try the same task with single domain approach only.