Groundwater recharge at the Nučice catchment

Study groundwater recharge at the Nučice catchment.

- Use measured volumetric water content and soil water potential to better predict effective soil hydraulic parameters.
- Compare the modeled water content with the measured data to do so.
- Use inverse modeling to obtain the best parameter set.
- Calculate recharge to groundwater level for each month of the modeled season.

Procedure

1 – Have a look at the data. Make graphs of rainfall, evaporation, and transpiration. Partition ET in evaporation and transpiration using NDVI and empirical formula from presentation. Plot also the SWC and SWP data.

2 – Prepare the H1D model. Use meteorological data as the upper boundary condition and free drainage as the lower boundary condition. Include root water uptake in the model. RUN THE MODEL. Put the modeled volumetric water content and soil water potential data into graph with the measured data.

3 – Change soil hydraulic characteristics “by hand” and try to model the measured data. Plot the modeled volumetric water content and soil water potential data into graph with the measured data. Also include the parameters you found.

4 - Prepare inverse solution problem in H1D and run it. Use the soil water content and soil water potential in two depths.

5 - Explore the results in *Inverse Solution Information* and *Observation Points*. Change the parameter margins or the initial value of parameters, if the results are not sufficient (in *Water Flow – Soil Hydraulic Prameters*). Put the modeled volumetric water content and soil water potential data into graph with the measured data. Include also the final (possibly best) parameter set.

5 – Show how much water recharge to GW and got in the soil profile for each month.

Instructions in red are mandatory hand-in.

Detail procedure

Ad1

P.csv:

DOY – Days Of Year
mm_day – Daily precipitation in mm

ET_0.csv:

DOY – Days Of Year
mm_day – Daily reference crop evapotranspiration mm
NDVI – normalized vegetation index
CC_perc – use formula from presentation
E_mm - Evaporation in mm = (1-CC/100) * ET
T_mm - Transpiration in m = (CC/100) * ET

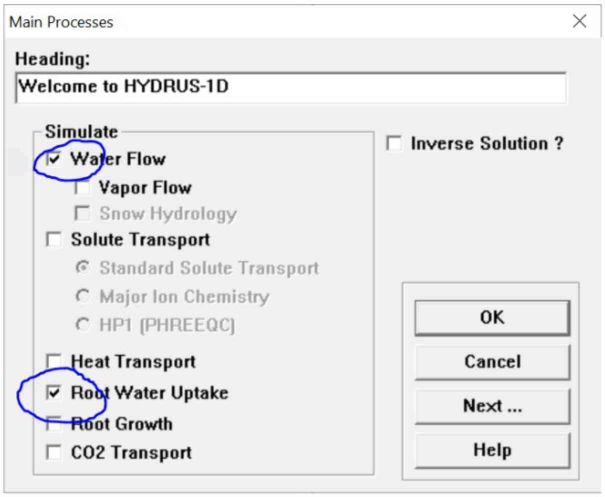
swc_swp.csv:

DOY – Days Of Year
Swc_30_ - soil water content in 30 cm
Swc_60_ - soil water content in 60 cm
Swp_30_kPa – soil water potential in 30 cm
Swp_60_kPa – soil water potential in 60 cm

Convert all to same units (including the model).

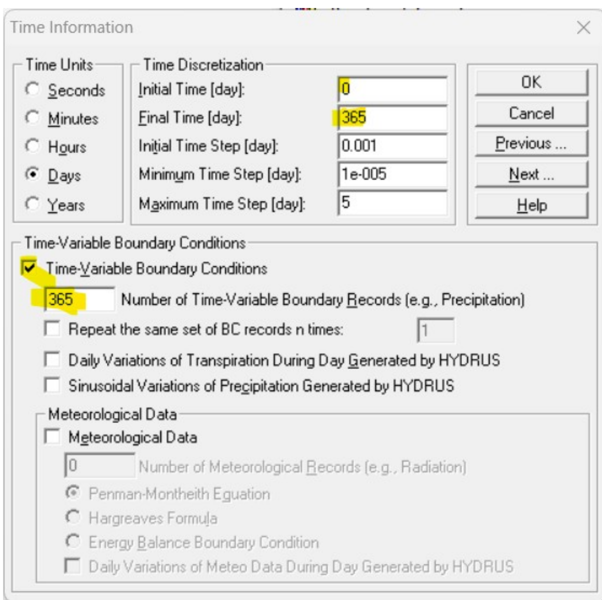
Ad2

Main processes:

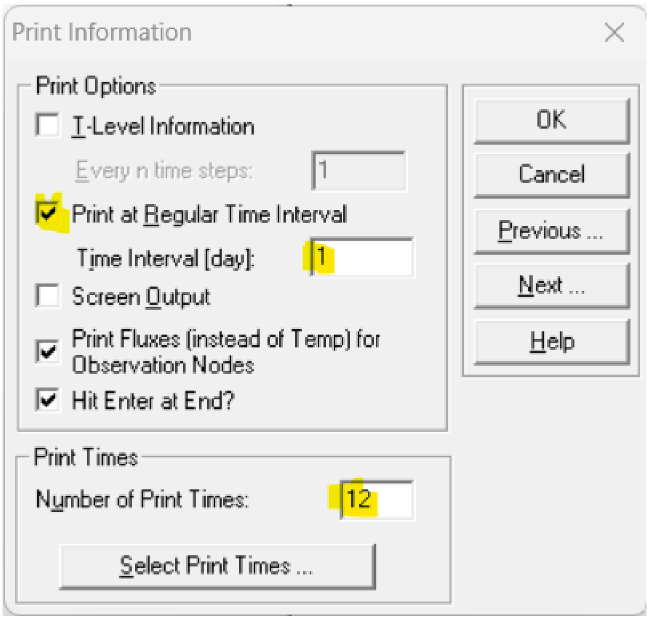


Geometry information: Soil profile of 65 cm.

Time information: Set the variable boundary condition. The number of Time-Variable Boundary condition is number of records of your meteorological data.



Print information: Print several times. You can use the default times.



Water Flow Parameters:

theta_r = 0.043 [cm^3/cm^3], theta_s = 0.509 [cm^3/cm^3], alfa = 0.02485 [1/cm], n = 1.189[-], Ks = 127 [cm/den]

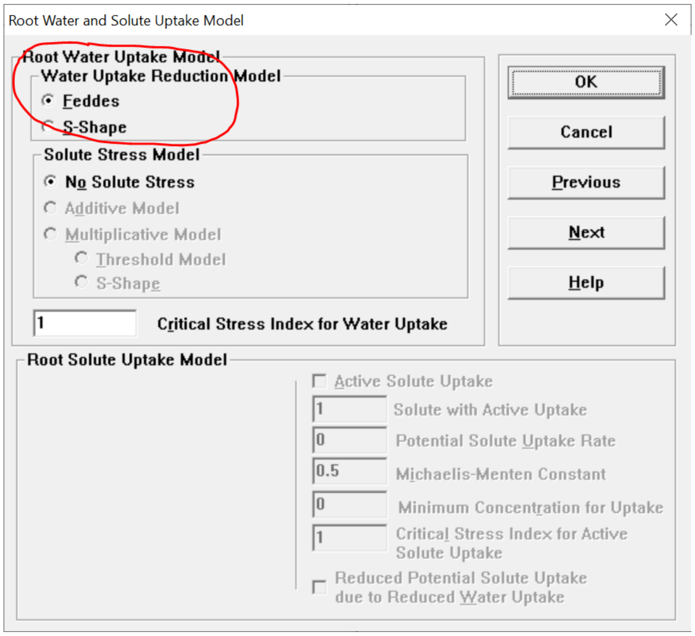
Water Flow Boundary Conditions:

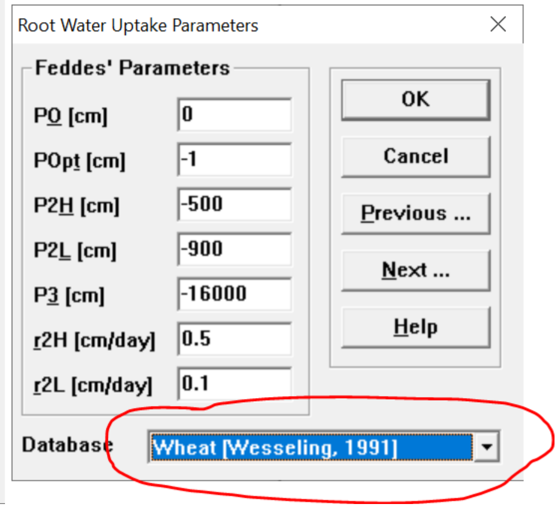
Upper BC: Atmospheric BC with surface runoff

Lower BC: Free drainage

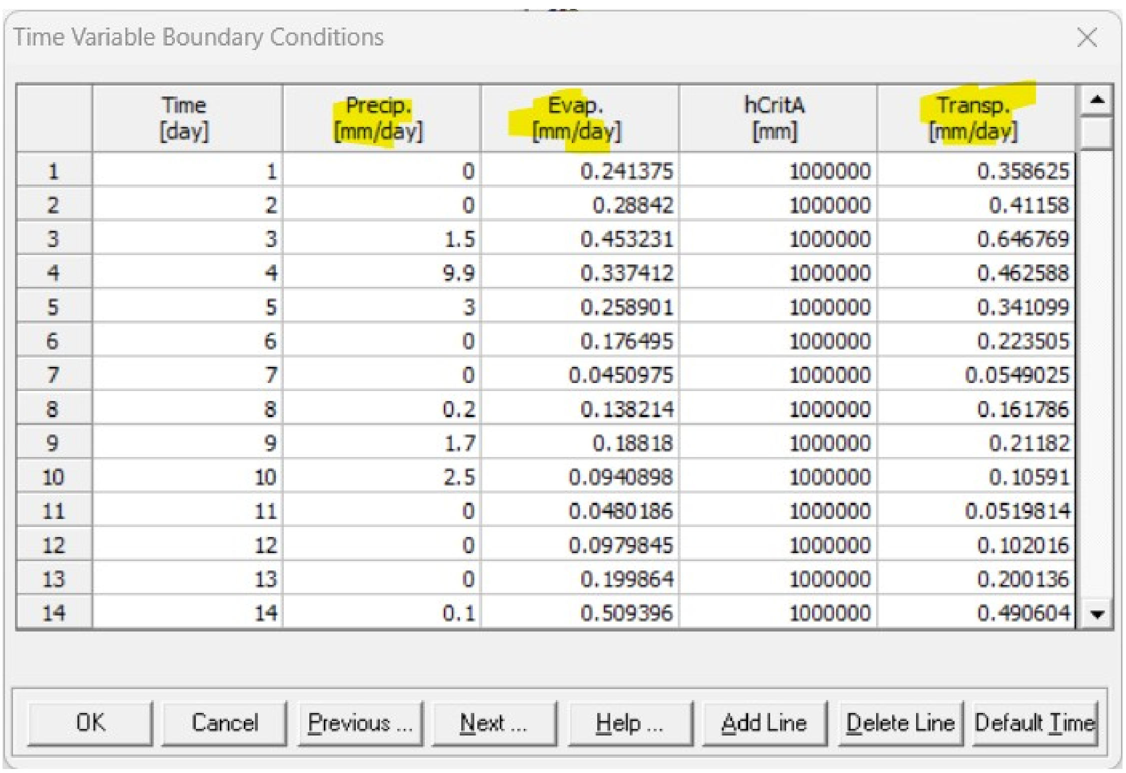
Root water and Solute uptake model

Use uptake reduction model of Feddes and parameters for Wheat in the Database





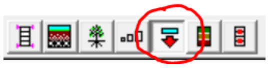
Time variable Boundary Condition: Copy + paste from input data.


Time Variable Boundary Conditions

	Time [day]	Precip. [mm/day]	Evap. [mm/day]	hCritA [mm]	Transp. [mm/day]
1	1	0	0.241375	1000000	0.358625
2	2	0	0.28842	1000000	0.41158
3	3	1.5	0.453231	1000000	0.646769
4	4	9.9	0.337412	1000000	0.462588
5	5	3	0.258901	1000000	0.341099
6	6	0	0.176495	1000000	0.223505
7	7	0	0.0450975	1000000	0.0549025
8	8	0.2	0.138214	1000000	0.161786
9	9	1.7	0.18818	1000000	0.21182
10	10	2.5	0.0940898	1000000	0.10591
11	11	0	0.0480186	1000000	0.0519814
12	12	0	0.0979845	1000000	0.102016
13	13	0	0.199864	1000000	0.200136
14	14	0.1	0.509396	1000000	0.490604

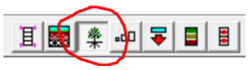
OK | Cancel | Previous ... | Next ... | Help ... | Add Line | Delete Line | Default Time

Soil Profile - Graphical Editor

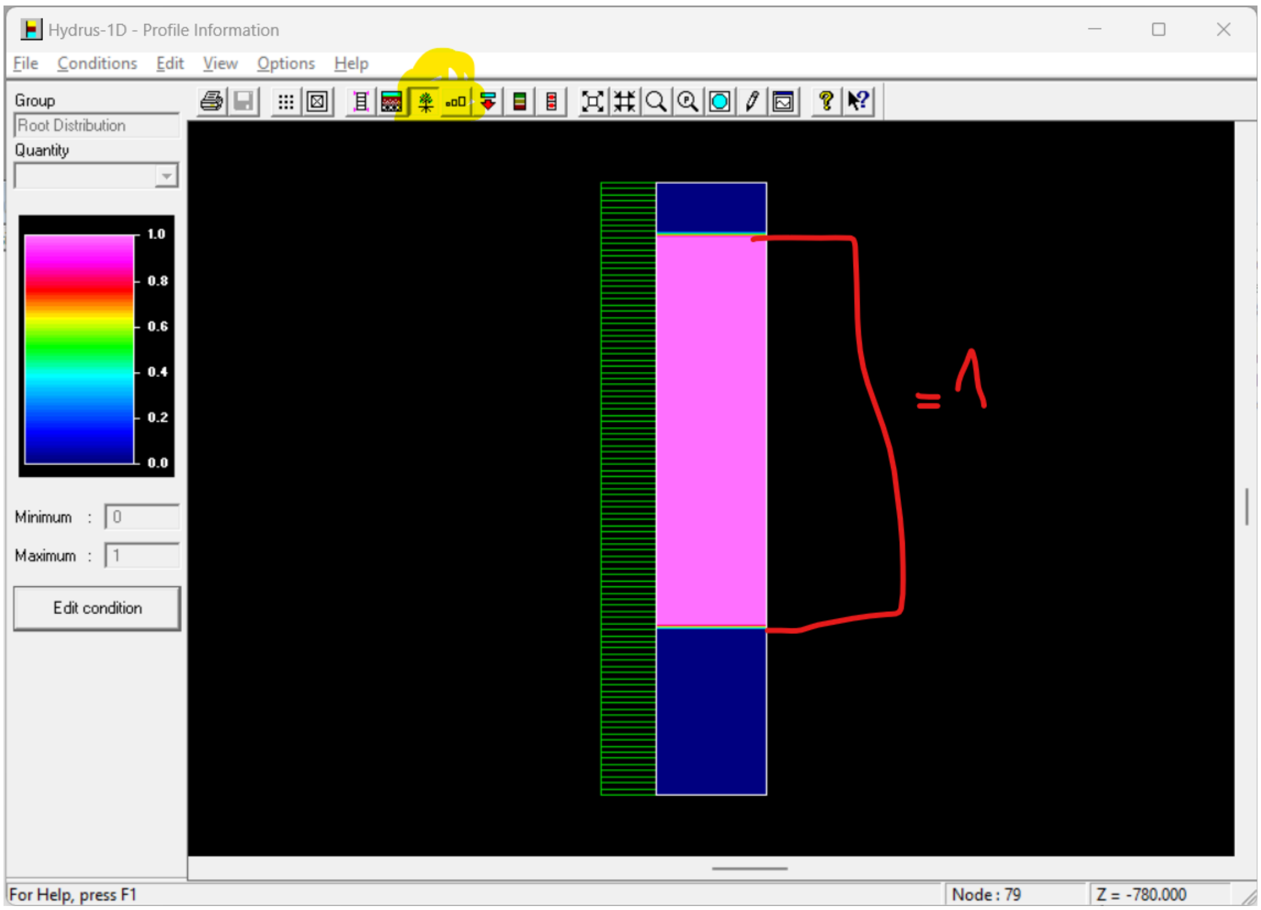


Initial condition: Set the initial pressure head based on the first monitored data.

Observation points: Put is one observation point to the depth of the -30 cm and -60 cm where the water content and soil water potential probes are, so you can compare the model results with the measured dat.



Root distribution:



NOW YOU CAN RUN THE MODEL. Have a look at the results when the calculation is successful.

Modeled data can be found in the directory: [directory with the project]/[project directory]/Obs_Node.out

Ad3

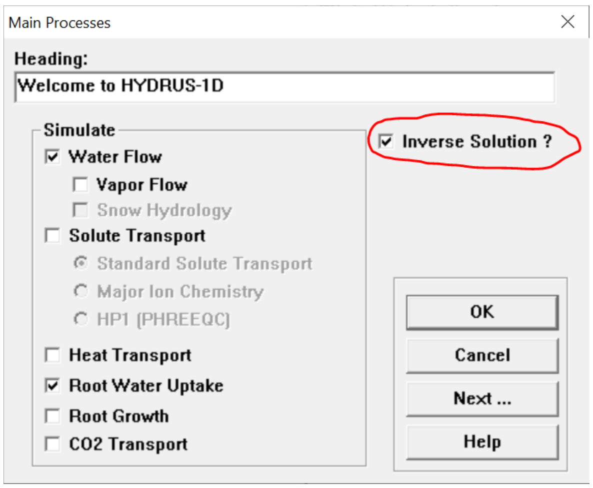
Change the soil hydraulic parameters and try to visually fit the model results with the measured data.

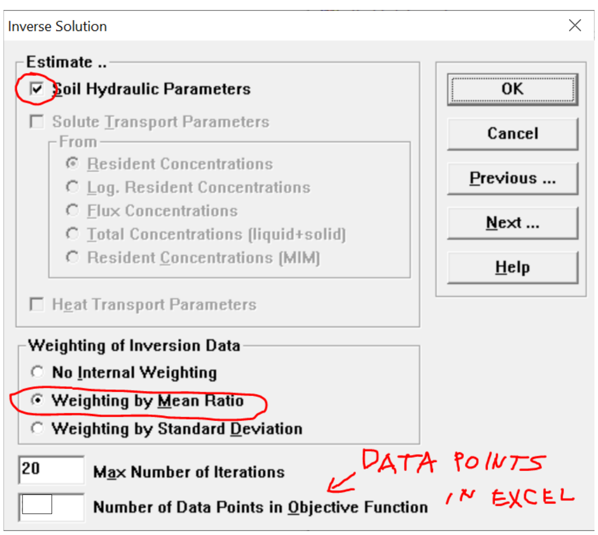
Modeled data are in the output: *observation points -> vertical variable: water content*

Copy the modeled water content into the excel sheet when you are satisfied with your results for comparison with the first run and observed data.

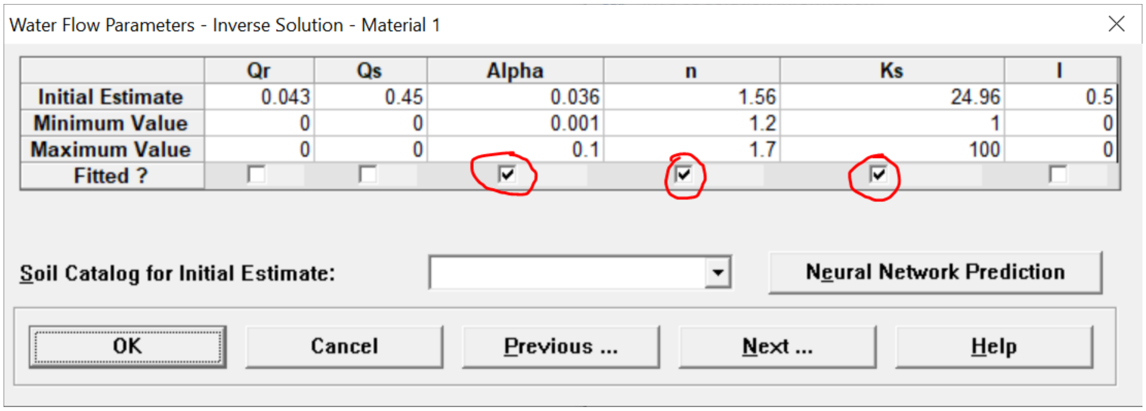
Modeled data can be found in the directory: [directory with the project]/[project directory]/Obs_Node.out

Ad4

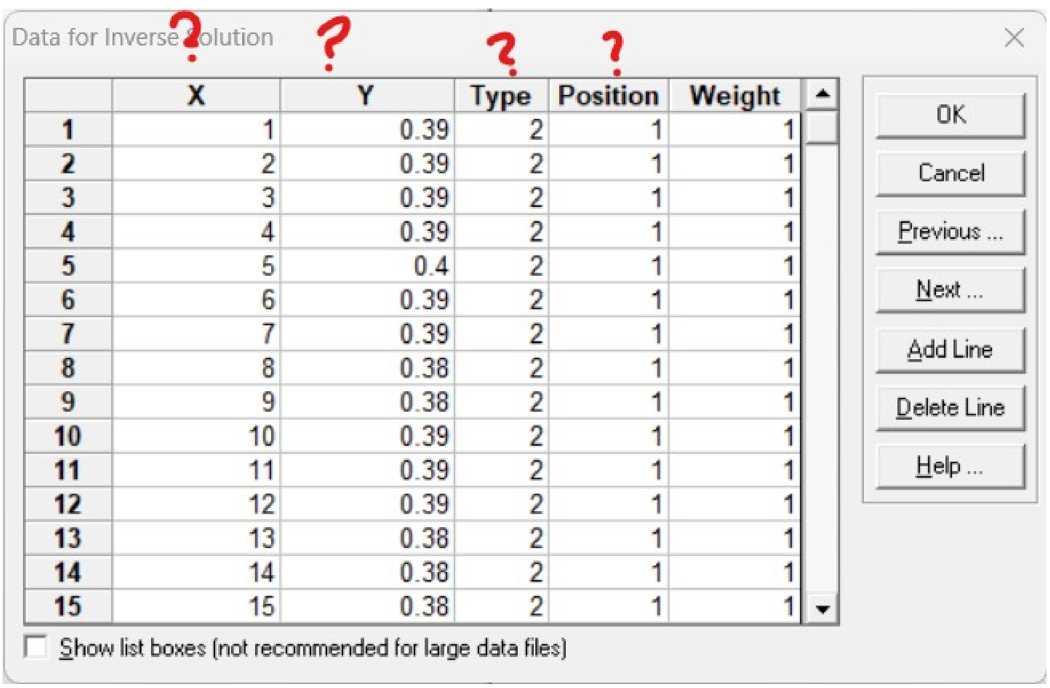




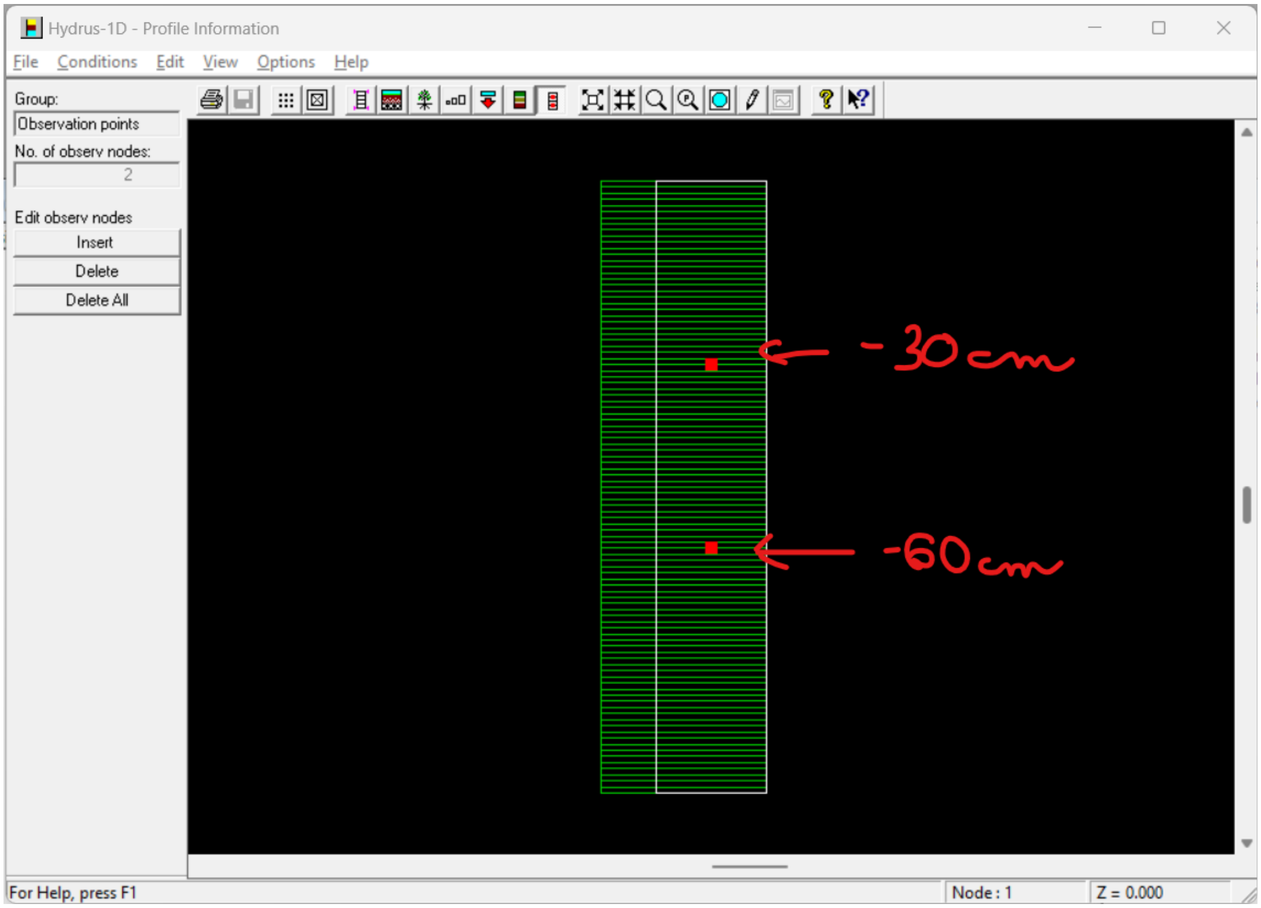
Number of data points are provided in the CSVs. The number is a number of rows.



Use saturated and residual water content from the „by hand“ optimization from prevous step the ‚by hand‘ calibration. Fit only alpha, n, and Ks. Choose reasonable minimal and maximum values and the initial estimation.



Fill the data for inverse solution table. Use help … to find out the meaning of the column X and Y and what should be in the column Type.

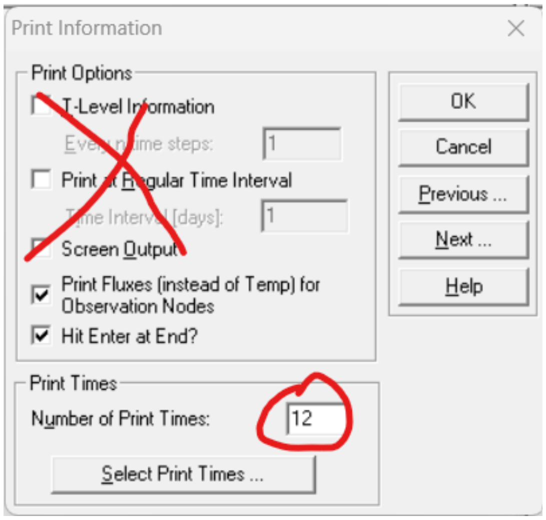


Check the soil profile – graphical editor. You need to have one observation point in the depth of -30 cm and -60 cm. This should have been done in the prevous step.

RUN THE MODEL!

Ad 5
Modeled data can be found in the directory: [directory with the project]/[project directory]/Obs_Node.out or in the file storing the inverse solution information [directory with the project]/[project directory]/Fit.out.

Ad6
To obtain results only in the end of each month try:



Modeled variables at boundaries can be found in the file: [directory with the project]/[project directory]/T_levels.out

In the file, you need to have a look at the columns:

sum(vTop): cumulative flow through the top boundary condition

sum(vBot): cumulative flow through the bottom boundary condition

Get the monthly inflows/outflows from the data and fill with them the table similar to a table below. Include only months in which you have data for all days in the month.

Month	Top [L]	Bottom [L]
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Make bar plot from the data in the table.