LysimeterGEO

D'Amato C., Tubini N., Bottazzi M. & Rigon R.

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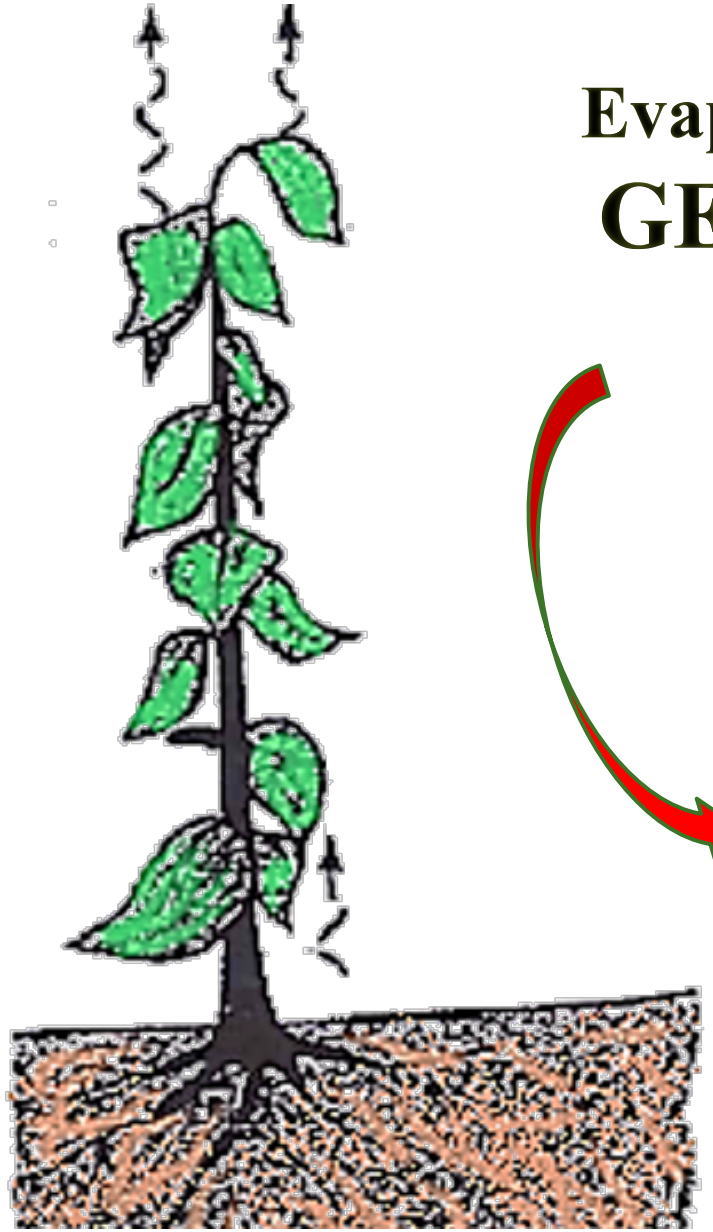


LysimeterGEO

EvapoTranspiration Model:

GEOframe-Prospero

(Bottazzi M. 2020)

Infiltration Model:

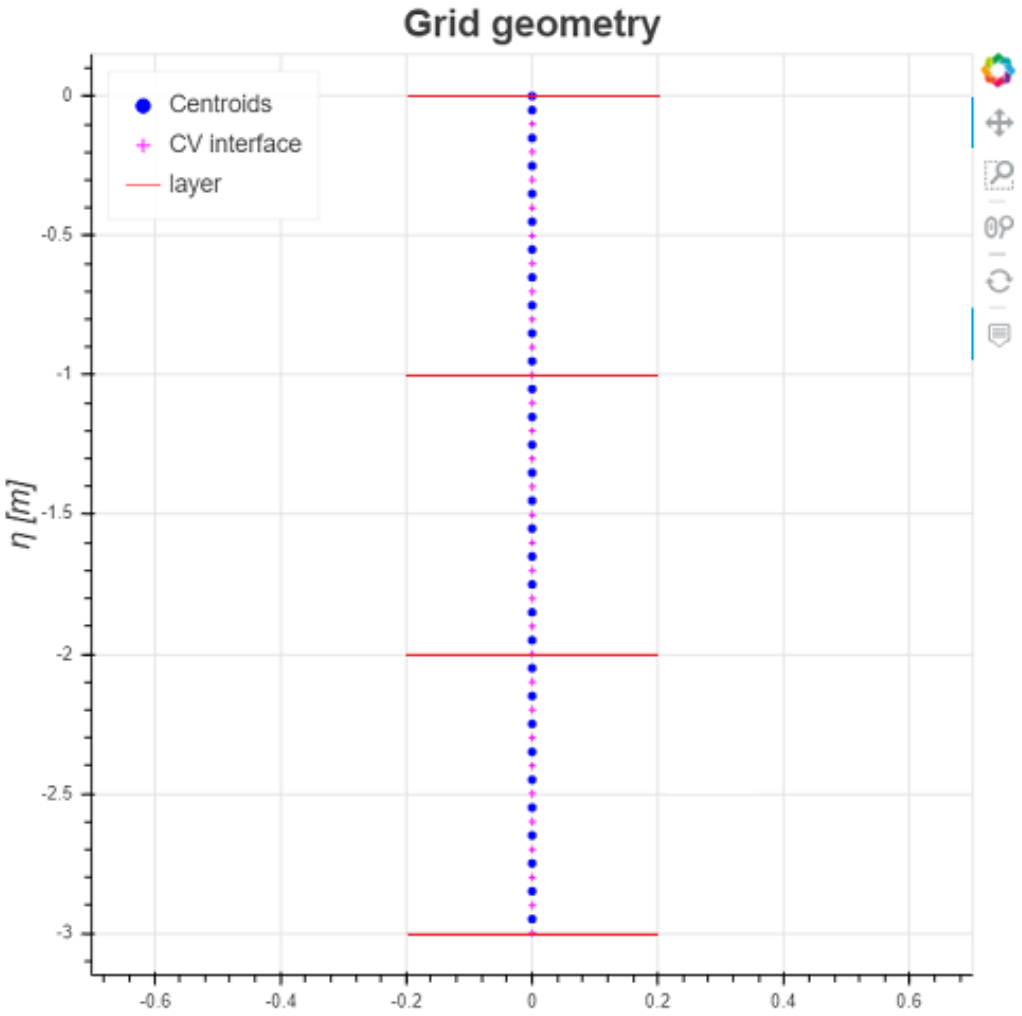
WHETGEO

(Tubini N. 2021)

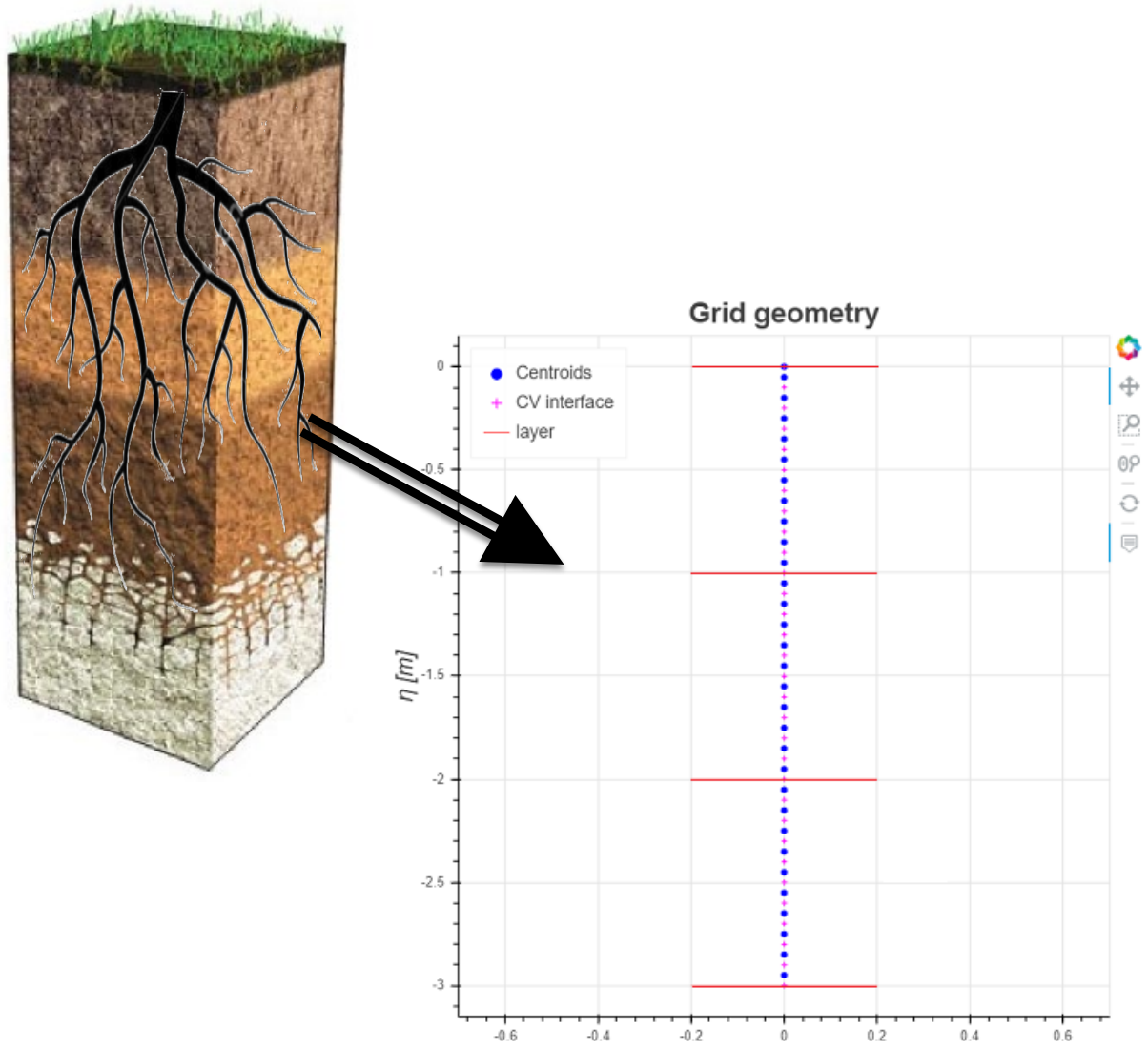
BrokerGEO

Grid definition

In order to apply the numerical model it is necessary to define a **grid** on which to calculate the solution.



Grid definition

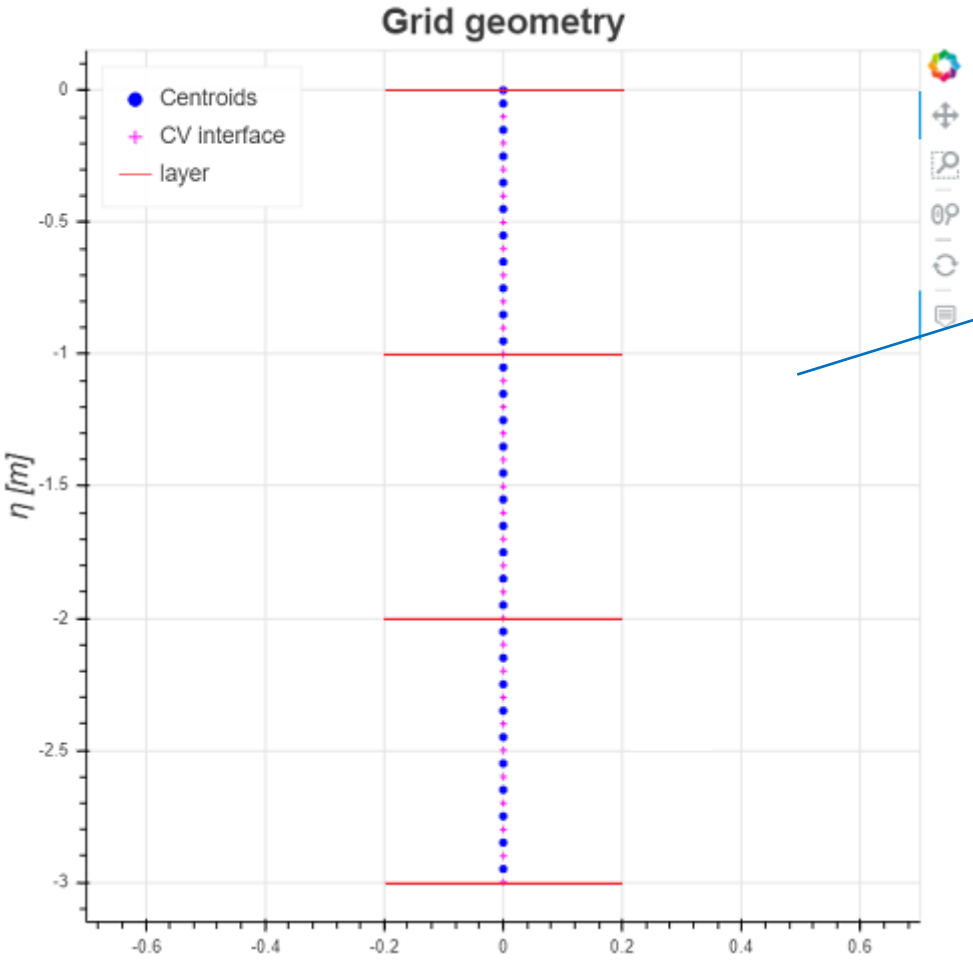


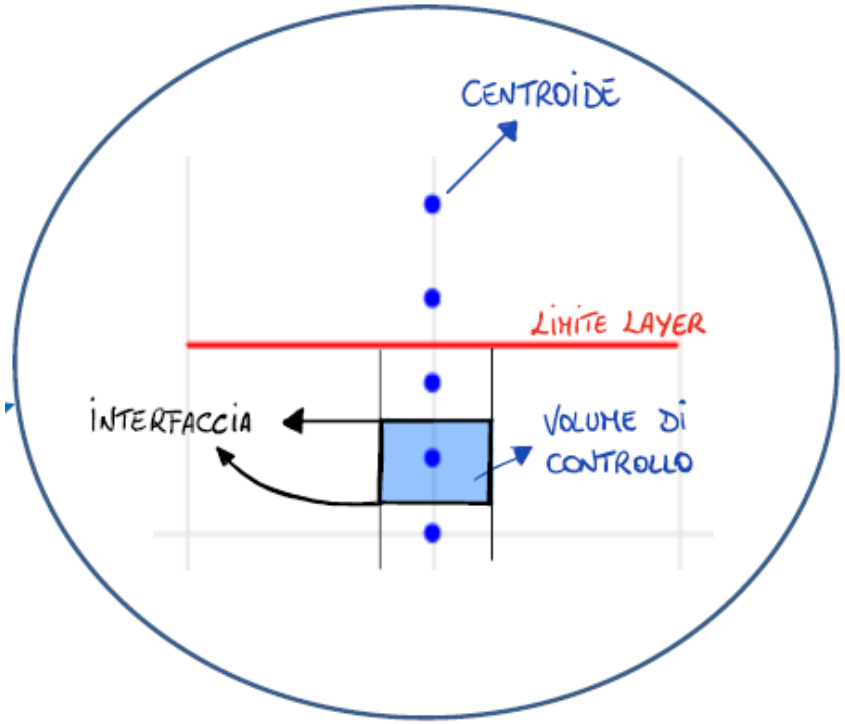
For the column of soil:

- Identify homogeneous **layers** and define their depth
- Determine / hypothesize the **parameters** of the **SWRC**
- Assume an **initial condition** for water **suction**, soil **temperature** and **root** distribution (use field measurements, if it is possible).

All this information must be placed in
files .csv

Grid definition





The grid consists of:

Layer → Soil layer

Control volumes

Control volume **centroids**

Interface between control volumes

Grid definition

```
grid_input_file_name = project_path + "/data/Grid_input/grid3layer_root.csv"

ic_input_file_name = project_path + "/data/Grid_input/ic_sat.csv"

icRoot_input_file_name = project_path + "/data/Grid_input/icRoot.csv"

parameter_input_file_name = project_path + "/data/Grid_input/TEST14_RichardsLysimeter_VG.csv"

dictionary_input_file_name = project_path + "/data/Grid_input/dictionary.csv"


grid_type =   'classical' #'classical' 'exponential' 'mixed'

dz_min = 0.005
dz_max = 0.1
b = 0.1
```

Grid definition

```
psi_interp_model = "linear"
T_interp_model = "linear"
root_interp_model = "linear"

etaR = -2

water_ponding_0 = 0
T_water_ponding_0 = 293.15


output_file_name =   project_path + "/data/Grid_NetCDF/GridPRIN.nc"
output_title = '''     '''
output_summary = '''    '''
```

Grid definition

grid_input_file_name.csv

grid3layer_root.csv

Delimiter: ,

	Type	eta	K	equationStateID	parameterID
1	L	0	100	1	1
2	L	-1	100	1	3
3	L	-2	100	1	2
4	L	-3	nan	nan	nan

Type

L: identifies a layer. The first and last row must always be layers (L).

M: identifies a suction measurement point. This point must belong to the computation domain both because it is to be used to reconstruct the initial suction profile and to validate the calculated solution**.**

Grid definition

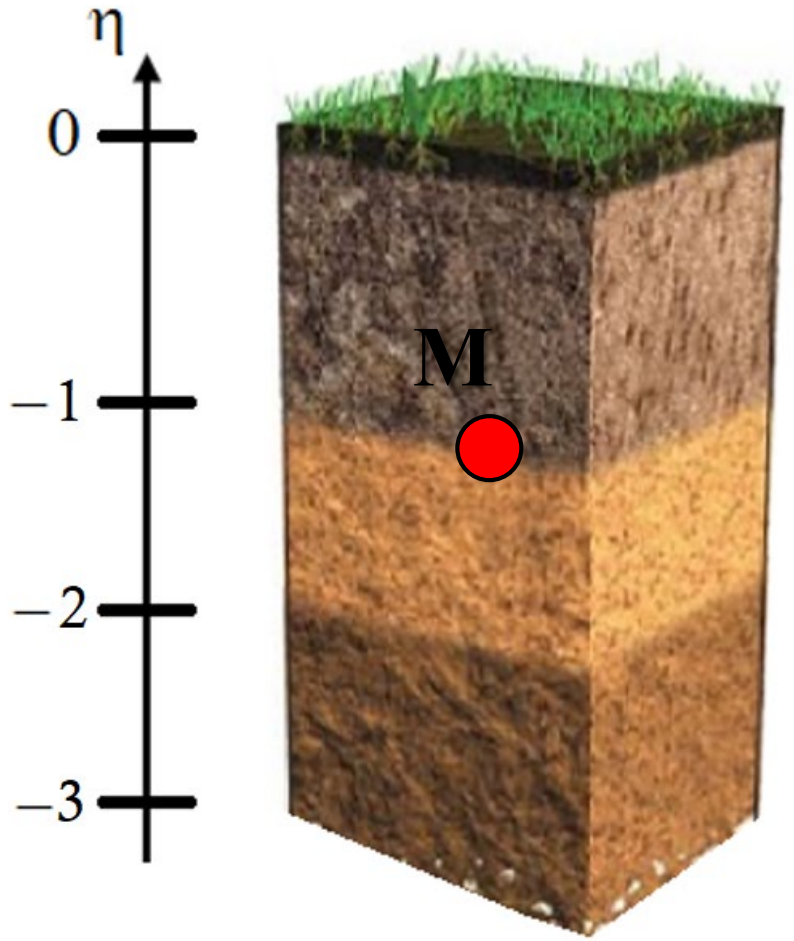
grid_input_file_name.csv

eta: is the upward positive vertical coordinate with origin fixed to the surface [m]

grid3layer_root.csv

Delimiter: ,

	Type	eta
1	L	0
2	M	-1
3	L	-2
4	L	-3



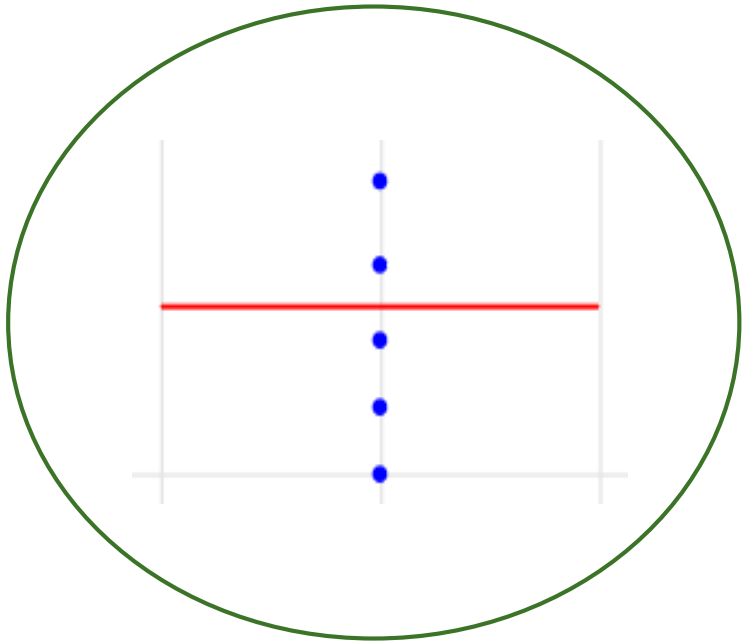
Grid definition

grid_input_file_name.csv

grid3layer_root.csv

Delimiter: ,

	Type	K
1	L	100
2	L	100
3	L	100
4	L	nan



K: number of control volumes in which the layer is to be discretized

Grid definition

grid_input_file_name.csv

grid3layer_root.csv

Delimiter: ,

	Type	parameterID
1	L	1
2	L	3
3	L	2
4	L	nan

parameterID: number refers to the set of parameter chosen

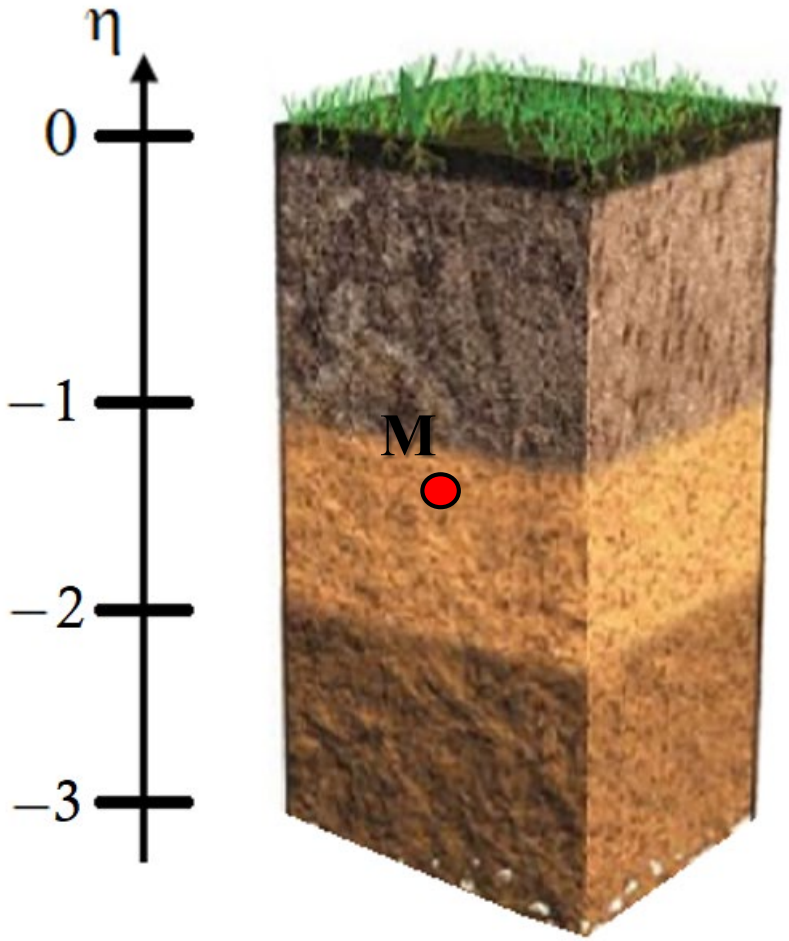
Grid definition

ic_input_file_name.csv

ic.csv

Delimiter: ,

	eta	Psi0	T0
1	-0.0	-3.0	293.15
2	-3.0	0.0	293.15
3			



Psi0: In this column you must enter the value of the initial condition for the suction.

T0: In this column you must enter the value of the initial condition for the soil temperature.

Grid definition

icRoot_input_file_name.csv

icRoot.csv

Delimiter: ,

	eta	Root0
1	-0.0	0
2	-0.3	0.0623
3	-0.55	0.0745
4	-0.65	0.0597
5	-0.75	0.0509
6	-0.85	0.0475
7	-0.95	0.0560
8	-1.25	0.0660
9	-1.5	0.0855
10	-1.8	0.0555
11	-1.9	0
12		

Root0: In this column you must enter the value of the initial condition for the root distribution.

Grid definition

parameter_input_file_name.csv

RichardsLysimeter_VG.csv

Delimiter: ,

	thetaS	thetaR	thetaWP	thetaFC	n	alpha	alphaSpecificStorage	betaSpecificStorage	Ks
1	#sand								
2	0.36689	0.05385	0.08385	0.33689	2.54723	2.991	0.0	0.0	5.40583E-05
3	#clay								
4	0.46291	0.06707	0.09707	0.43291	1.65275	0.445	0.0	0.0	5.18521E-06
5	#silt								
6	0.48664	0.13335	0.16335	0.45664	1.34174	0.846	0.0	0.0	9.73284E-07

Grid definition

RichardsLysimeter_VG.csv

Delimiter: ,

	thetaS	thetaR	thetaWP	thetaFC
1	#sand			
2	0.36689	0.05385	0.08385	0.33689
3	#clay			
4	0.46291	0.06707	0.09707	0.43291
5	#silt			
6	0.48664	0.13335	0.16335	0.45664

parameter_input_file_name.csv

thetaS: water content at saturation[-].

thetaR: water content residual[-].

thetaWp: water content at wilting point [-].

thetaFc: water content at field capacity [-].

Grid definition

parameter_input_file_name.csv

RichardsLysimeter_VG.csv

Delimiter: ,

	thetaS	n	alpha	alphaSpecificStorage	betaSpecificStorage	Ks
1	#sand					
2	0.36689	2.54723	2.991	0.0	0.0	5.40583E-05
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5	#silt					
6	0.48664	1.34174	0.846	0.0	0.0	9.73284E-07

alphaSpecificStorage: It is the compressibility of the aquifer expressed in $[Pa^{-1}]$

betaSpecificStorage: It is the compressibility of water expressed in $[Pa^{-1}]$ (it can be assumed constant and equal to $4.4\ 10^{-10}\ Pa^{-1}$)

Ks: hydraulic conductivity $[m/s]$.

Grid definition

parameter_input_file_name.csv

```
// Available SWRC models:
// - "Van Genuchten"
// - "Kosugi"
// - "Brooks Corey"
// - "Romano"
// - "Van Genuchten Bachmann"
// - "Brooks Corey Bachmann"
"solver.soilHydraulicModel" "Van Genuchten"
```

Create all the input.csv files

Run the **notebook** *1_Grid1D_RichardsLysimeter.ipynb*

Thank you very much for your attention