University of PADOVA
A.Y. 2021 – 2022
GROUNDWATER HYDROLOGY

EXAM ASSIGNMENT
Precision irrigation Modelling of a cranberry field in Quebec (Canada)

Students are requested to simulate a case study in Quebec (Canada), representing half vertical cross-section of an agricultural field, where water table levels are controlled by a drain and the pressure head in the unsaturated zone is kept within an optimal range for cranberry production. Students can use either the CATHY model, which has been described during the course, or any other suitable software (e.g., Feflow). Specific tasks required in the assignment are:
1. setting up of the model;
2. sensitivity analysis to the main parameters and initial conditions;
3. assessment of the model performance with an objective goodness-of-fit metric (e.g., root mean square error, Kling-Gupta efficiency index, etc.)
4. representing the results of the best model configuration with appropriate graphics.

In the following, only essential information to set up the case study is reported, while further useful details are reported in Gumiere et al. (2020), provided in the Moodle website of the course.

Model setup

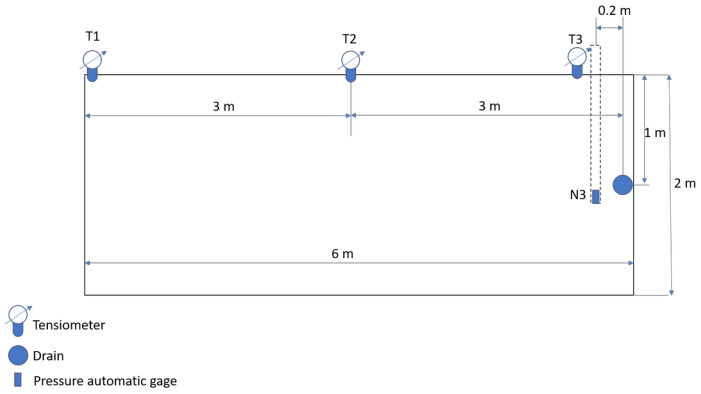


Figure 1: Sketch of the model domain, including the locations of the tensiometers, the drain and the pressure automatic gage.

- The tensiometers are located at 10 cm depth from the soil surface at the locations reported in Figure 1.
- The drain is located at 1 m depth from the soil surface.
- Due to symmetry, the model domain represents one half of the entire field (6m instead of 12m).

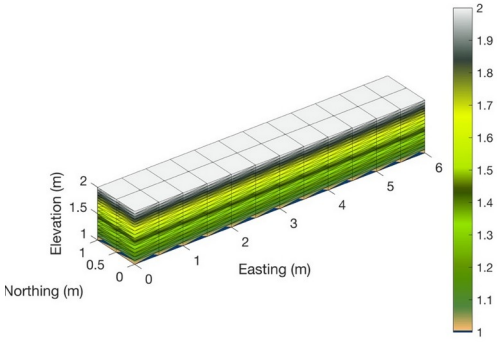


Figure 2: Mesh sample

Time resolution and Data availability

- Data set duration and resolution

Hourly data from 18 June 2018 to 10 September 2018 (7261200 s)

Atmospheric boundary conditions

Rain [mm/hour]

Potential ET [mm/hour]

Atmospheric forcing (file “atmbc”) estimated as net rain (rain minus potential evapotranspiration). Boundary conditions at the drain can be imposed as in Freeze and Cherry (1979), chapter 5.4.

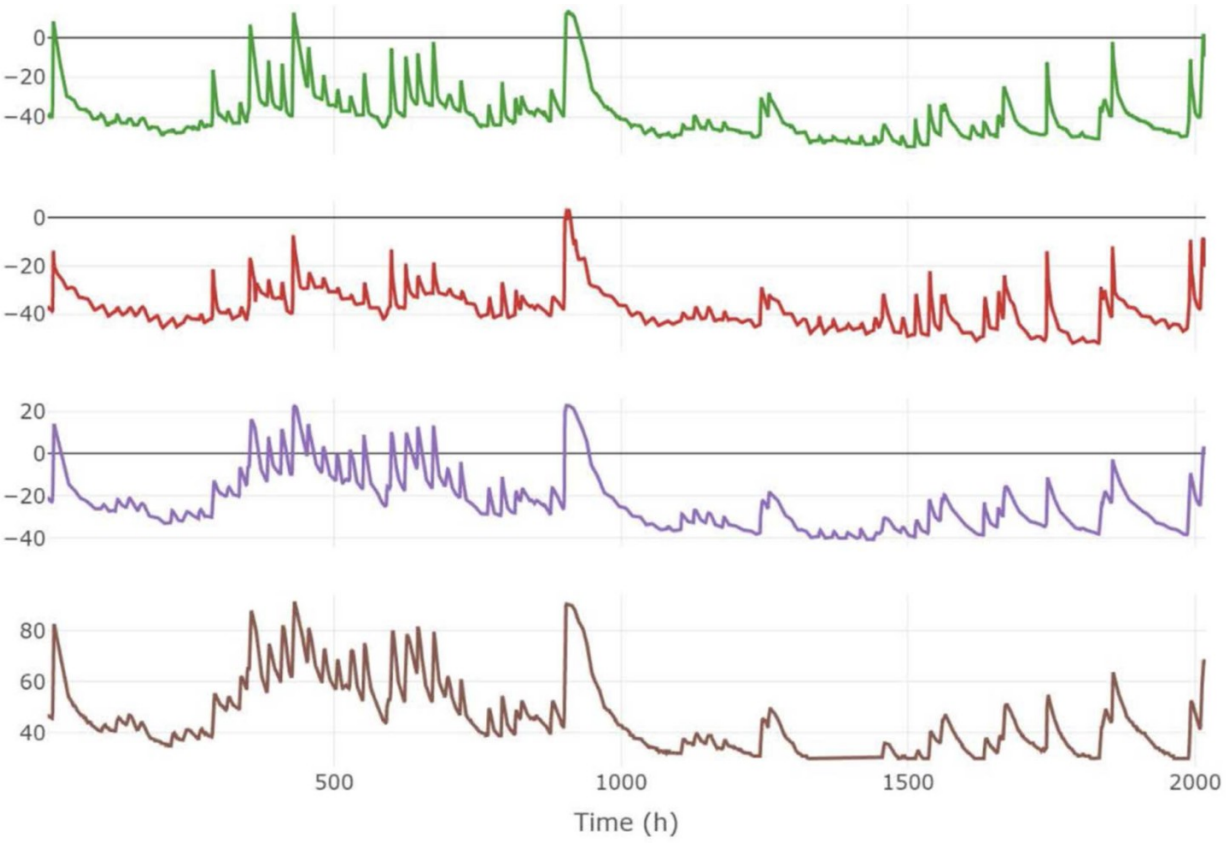
Feddes approach for computation of actual ET

Tabella2: Example of Feddes' parameters – file 'soil'

	FEDDES' PARAMETERS [kPa]	**FEDDES' PARAMETERS [mH2O]**
PCANA (h1)	**-4.5**	**-0.458885**
PCREF (-h3)	-7.5	-0.764808
PCWLT (-h4)	-30	-3.0592
ZROOT	0.15 m	0.15 m
PZ	0	0
OMGC	1	1

Available Measurements for calibration/validation

Pressure head [cm, first three plots, T1, T2 an T3] and water table position [cm] – see Figure 1 for the locations.



REFERENCES

Gumiere SJ, Camporese M, Botto A, Lafond JA, Paniconi C, Gallichand J and Rousseau AN (2020) Machine Learning vs. Physics-Based Modeling for Real-Time Irrigation Management. Front. Water 2:8. doi: 10.3389/frwa.2020.00008