Name: *N^o sciper:*

Mid term – Hydrology for engineer

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Question 1 (30/100)

On the roof of a building there is a garden of area $A = 2 \times 4$ m^2. The soil has a depth of $Z = 30$ cm and porosity of $n = 0.3$. Outflows comprise actual evapotranspiration $ET(t)$ and leakage from the bottom through a drainage system, $L(t)$. Vegetation is never under stress and the crop coefficient associated with the garden is $K_c = 0.6$. Surface runoff is negligible, hence all precipitation J enters the soil as infiltration. If the soil becomes saturated, the excess precipitation accumulates above the soil. The initial soil saturation (which is the water storage divided by the available pore volume) is $s_0 = 0.5$.

a) Write a hydrologic balance equation for the considered rooftop.

b) You are given mean values of precipitation intensity J, leakage L and potential evapotranspiration ET_0 every 10 minutes during a strong precipitation event. Compute the storage at the end of every time interval and report your results in the table below.

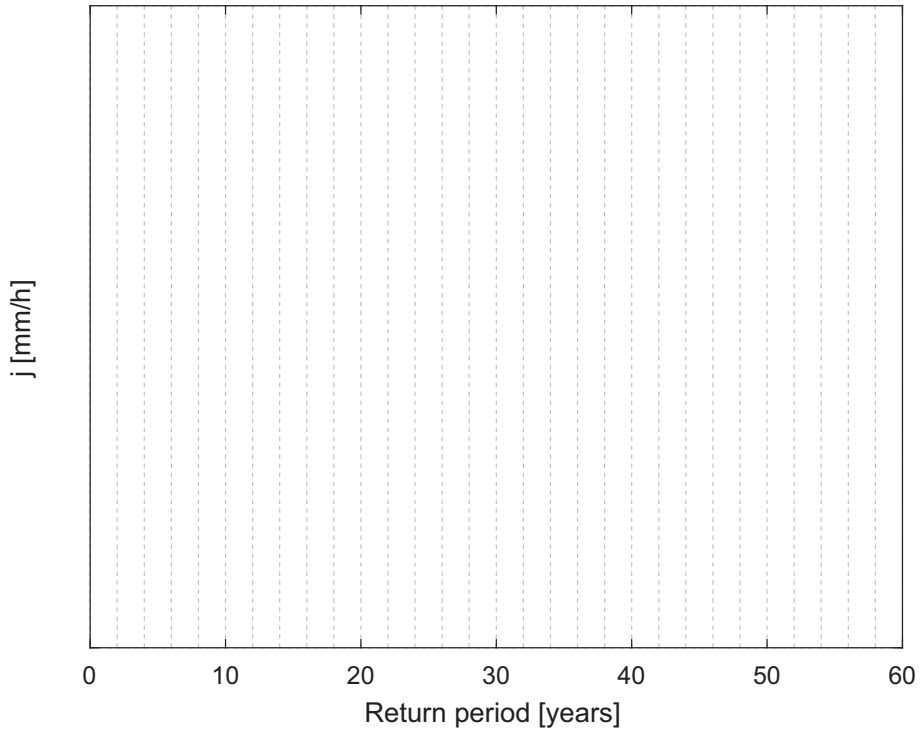
time interval (minutes)	J [mm/hour]	L [m^3/hour]	ET_0 [mm/hour]	S [mm]
0 - 10	4.0	0.0096	4.0	
10 - 20	4.0	0.024	1.0	
20 - 30	8.0	0.024	1.0	
30 - 40	16.0	0.048	1.0	
40 - 50	24.0	0.096	0.0	
50 - 60	30.0	0.096	0.0	

c) Is the soil saturated at the end of the storm? If not, how many liters of water are missing to reach saturation? If yes, what is the volume of water accumulated on the soil surface?

Question 2 (20/100)

You have to analyze the maximal annual precipitations at a given location using the Gumbel distribution. The parameters of the Gumbel distribution for events of duration 3 hours at this location are: $\alpha = 0.115$ mm^{-1} and $u = 27.3$ mm.

a) Use the Gumbel distribution to compute rainfall depths corresponding to the return periods $T = 2, 10$ and 30 years. Report the corresponding mean rainfall intensities j in the figure below (you can interpolate the points by hand to obtain a continuous curve). The Gumbel cumulative distribution formula is: $P(x) = e^{-e^{-\alpha(x-u)}}$



b) For the same location, what is the return period of a 3-hours event with 62 mm of water? Report your formulas.

Question 3 (30/100)

a) Given a random variable $\mathbb{X} \in (0, +\infty)$ describing yearly maxima, define the return period of an event $A : \{\mathbb{X} \geq x_T\}$. Derive the result in full detail.

b) Define the hydrologic risk of failure $\overline{R}$ with reference to a given number of years of expected life of a structure. Determine the hydrologic risk of a 35-year flood during the 30-year service life of a structure.

Question 4 (20/100)

a) Describe the Green and Ampt method for computing infiltration rates in soils.

Extra pages for computations