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EXERCISE 4

Calculate the actual evapotranspiration [mm] for the period. The following data were measured at a lysimeter station:

Volume of soil	1 m^3
Mass of the lysimeter (begin)	2113 kg
Mass of the lysimeter (end)	2104 kg
Precipitation depth (begin – end)	58.3 mm
Recharge	28.8 L
Density of water	1 g/cm^3

$Et_{act} = P – R - \Delta W$

$\Delta W = W_{end} - W_{begin}$ = 2104 kg/m^3 – 2113 kg/m^3 = - 9 kg/m^3 (Unit volume!)
→ - 9kg/m^3 = – 9 L/m^3 (density= 1 g/cm^3) equal to - 9 mm (per m^2)
(Remember: 9 kg are lost, negative sign!)

Recharge R = 28.8 L per unit volume! = 28.8 L/m^3
→ 28.8 L/m^3 equal to 28.8 mm (per m^2)

Et_{act} = P – R - ΔW = 58.3 mm – 28.8 mm – (- 9 mm) = **38.5 mm**

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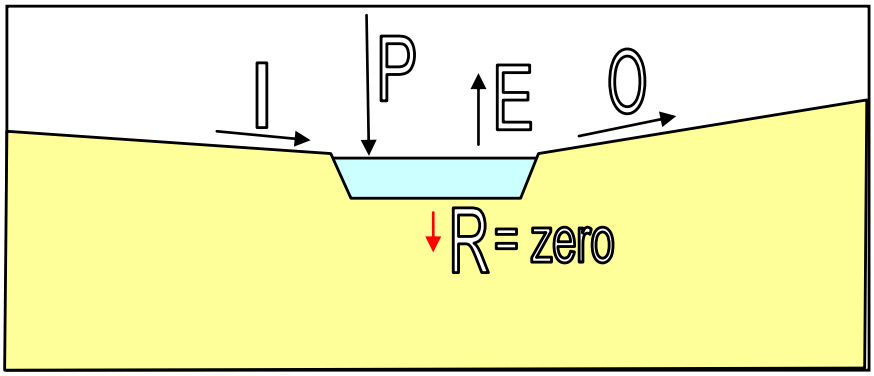
EXERCISE 5

The following data were measured at a water reservoir (5 km^2 water surface area, impermeable layer/ no leakage at the bottom):

Precipitation rate	4 mm/24 hrs
Change in water level of reservoir due to evaporation	- 1.9 mm
Inflow (tributary river) into the reservoir	100 L/sec
Outflow from the reservoir	40 L/sec

a. Schematically depict the water budget.
b. Formulate the water balance for the lake.
c. Calculate the evaporation losses [mm] during 24 hrs.
d. Calculate the total volume of evaporated water.

a)



b) Influx – Outflux = $dV/dt = V_P + V_{in\text{-}Out} - V_{ET} - V_{\Delta wl}$

c) Volume of precipitation (**Note: 1 mm = 1 L/m^2 = 10^3 m^3/km^2**)
V_P = 4 mm * 5 km^2 = 4 * 10^3 m^3/km^2 * 5 km^2 = 20000 m^3

Inflow – outflow = 100 L/s – 40 L/s = 60 L/s = 60 L/s * 10^{-3} m^3/L = 0.06 m^3/s
In 24 hrs: $V_{in\text{-}out}$ = 0.06 m^3/s * 24 hrs (60*60 s/hrs) = 5184 m^3

d) Volume of water evaporated :
Δwl = -1.9 mm * 5 km^2 = -1.9 10^3 m^3/km^2 * 5 km^2 = -9500 m^3

$V_{ET} = V_P + V_{in\text{-}Out} - V_{\Delta wl}$
V_{ET} = 20000 m^3 + 5184 m^3 – (-9500) m^3 = 34684 m^3
ET = V_{ET}/ Area = 34684 m^3 / 5 km^2 = 34684 m^3 / (5 km^2* 10^6 m^2/km^2)
ET = 6.937*10^{-3} m = 6.937 mm

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EXERCISE 3b - OPTIONAL

For the surface area supplied, calculate the average precipitation depth, precipitation volume and precipitation yield using the:

a. Arithmetic average
b. Thiessen method
c. Isohyetal method.

Assuming 3% recharge of MAP and no groundwater inflows:

d. Schematically depict the hydrological balance and the volume of water available for overland flow, interflow and baseflow.
e. Address whether a farmer located at the residential dwelling can safely pump water consistently at 0.4 litres per second without affecting the streamflow.

Station	*Depth of precipitation [mm]*
1	980
2	1050
3	1100
4	850
5	970
6	830
7	770
8	720