ITU
CIVIL ENGINEERING FACULTY HYDRAULICS DIVISION
HYDROLOGY

EXAMPLES –3 EVAPOTRANSPIRATION

EVAPOTRANSPIRATION

Q1. The reservoir surface area of a dam is given as 32 km^2. The daily heat energy absorbed by the reservoir is 500 kal/cm^2 and the albedo of the water surface is 10%. Calculate the daily evaporation volume in the shade (the heat variations due to the inflow and outflow will be neglected and the temperature of the reservoir will be assumed to be constant).

$$E = \frac{Hi - H0 - \Delta H}{L(1+R)}$$

H_i=Incoming heat (sunshine and inflow heat)=**500 cal/cm^2**
Albedo = reflection ratio of heat reaching the earth's surface =**%10**
(for plants = 0.05-0.025…..for water = 0.05-0.15…..for snow = 0.050-0.090)
H_0 = Outflow heat plus heat reflected from the surface = **500*0.1=50 cal/cm^2**
ΔH= Heat required for change in water temperature = **0**
R=Bowen Ratio=(Heat loss from the surface by conduction/evaporation energy)=**0.2-0.3**
L=specific evaporation heat of water **(under normal atm. conditions 590 cal/cm^3)**

$$E = \frac{Hi - H0 - \Delta H}{L(1+R)} = \frac{500 - 50 - 0}{590(1+0.25)} = 0.61cm$$ Daily evaporation heigth

daily evaporation volume = 0.00061m*32*$10^6 m^2$=1.952.000 m^3

EVAPOTRANSPIRATION

Q2 A 100 km^2 sized area near Diyarbakır is being used for the purposes given below. Considering there is no precipitation in summer months calculate how much irrigation water is needed in summer months using Blaney-Criddle formula.

Plant	Growth Area (km^2)	k (seasonal)	Month	Mean Temp. (°C)	p	U(mm)
Wheat	80	0.8	June	26	0.1008	
			July	31	0.1022	
Clover	20	0.4	August	30.2	0.0954	
			September	25	0.0839	

EVAPOTRANSPIRATION

Q2 $U=45k.p.(t+18)$

U=Monthly Evapotranspiration
k=coefficient related to planting
p=ratio of dayligth duration of the month to the annual dayligth duration
t=monthly mean temperature

Plant	Growth Area (km^2)	k (seasonal)	Month	Mean Temp. (°C)	p	U(mm)
Wheat	80	0.8	June	26	0.1008	159.67
			July	31	0.1022	180.28
Clover	20	0.4	August	30.2	0.0954	82.76
			September	25	0.0839	64.94

According to these U1=159.67 mm U2=180.28 mm
U3=82.76 mm U4=64.94 mm

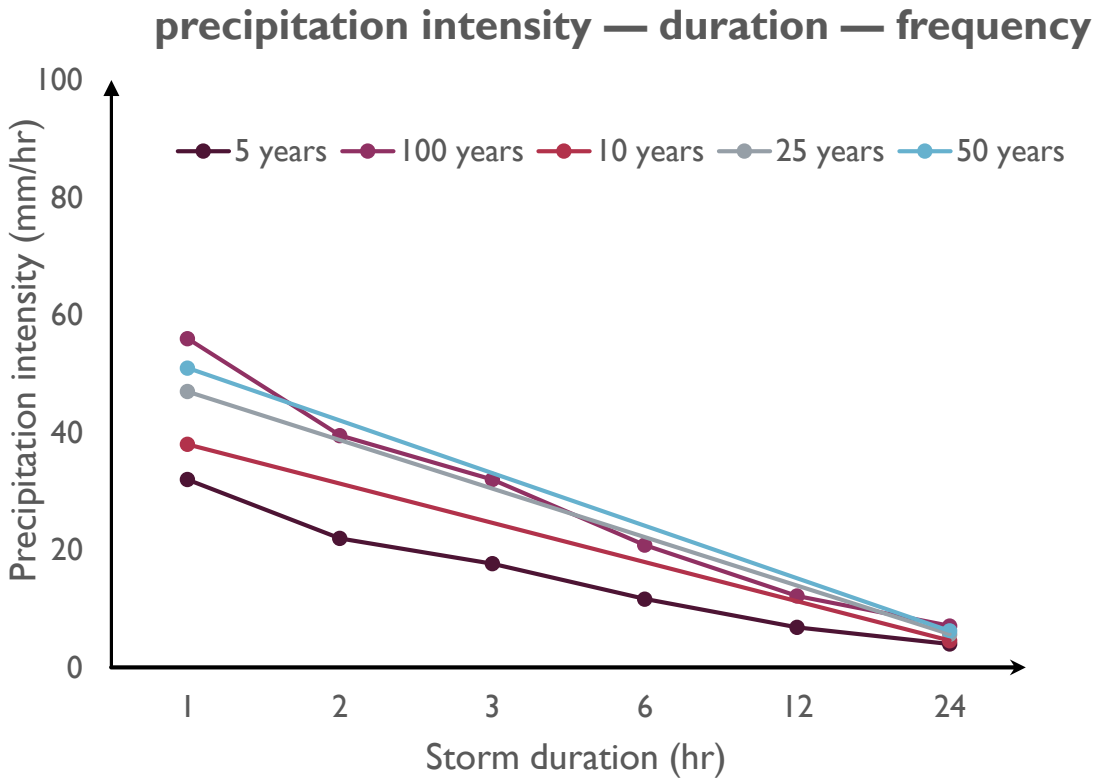
Necessary Irrigation Water $=U1*80*10^6=12\ 773\ 600\ m^3$
$=U2*80*10^6=14\ 422\ 400\ m^3$
$=U3*20*10^6=1\ 655\ 200\ m^3$
$=U4*20*10^6=1\ 295\ 800\ m^3$

Storm Duration (hour)	Return Period (year)	Total Precipitation P (mm)	Precipitation Intensity i (mm/hour)
1	5	32	
	10	38	
	25	47	
	50	51	
	100	56	
2	5	44	
	100	79	
3	5	53	
	100	96	
6	5	70	
	100	125	
12	5	82	
	100	146	
24	5	96	
	10	110	
	25	136	
	50	150	
	100	170	

Q3 In Maden precipitation gage located in the Dicle Dam basin the precipitation values for the durations 1, 2, 3, 6, 12 and 24 hours, and for return periods 5, 10, 25, 50 and 100 years are given below. Draw the "*precipitation intensity — duration — frequency*" curve of Maden precipitation gage using this information.

Precipitation intensity = $\Delta P / \Delta t$

Storm Duration (hour)	Return Period (year)	Total Precipitation P (mm)	Precipitation Intensity i (mm/hour)
1	5	32	*32*
	10	38	*38*
	25	47	*47*
	50	51	*51*
	100	56	*56*
2	5	44	*22*
	100	79	*39.5*
3	5	53	*17.67*
	100	96	*32*
6	5	70	*11.67*
	100	125	*20.83*
12	5	82	*6.83*
	100	146	*12.17*
24	5	96	*4*
	10	110	*4.58*
	25	136	*5.67*
	50	150	*6.25*
	100	170	*7.08*



EVAPOTRANSPIRATION

Q4. Calculated potential evapotranspiration and measured precipitation values in Dicle Dam basin during 1971 are given in the following table. The maximum moisture that soil can hold corresponds to 100 mm precipitation and soil moisture will be assumed to be 0 at the beginning of October. Calculate the actual monthly evapotranspiration and flow depth values.

Months	O	N	D	J	F	Mr	Ap	My	Jn	Jy	Ag	S
U_p (mm) (Pot. Evapotranspiration)	100.5	24.4	3.2	19.4	13	34.6	90.5	118.4	198.3	217	200.5	160.3
P (mm) (Precipitation)	17.3	75.8	10.8	74	80.2	177.5	8.5	7.2	0	0	0	23.1
F (mm) (Change in the soil moisture)												
Z (mm) (Soil moisture at the end of month)												
U_g (mm) (Actual evapotranspiration)												
R (mm) (Flow depth)												

EVAPOTRANSPIRATION

Months	O	N	D	J	F	Mr	Ap	My	Jn	Jy	Ag	S
U_p (mm) (Pot. Evapotranspiration)	100.5	24.4	3.2	19.4	13	34.6	90.5	118.4	198.3	217	200.5	160.3
P (mm) (Precipitation)	17.3	75.8	10.8	74	80.2	177.5	8.5	7.2	0	0	0	23.1
F (mm) (Change in the soil moisture)	0	51.4	7.6	41	0	0	-82	-18	0	0	0	0
Z (mm) (Soil moisture at the end of month)	0	51.4	59	100	100	100	18	0	0	0	0	0
U_g (mm) (Actual evapotranspiration)	17.3	24.4	3.2	19.4	13	34.6	90.5	25.2	0	0	0	23.1
R (mm) (Flow depth)	0	0	0	13.6	67.2	142.9	0	0	0	0	0	0