Problem 3 Watershed Hidrology

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1 - Penman Potential Evapotranspiration

1.1 Data

```
Tavg_Aug2 <- 18.6 #Celsius
Tma_Aug2  <- 24.4 #Celsius
Tmin_Aug2 <- 12.8 #Celsius
Tavg_Aug1 <- 15.0 #Celsius
Tavg_Aug3 <- 20.6 #Celsius
VPD = 1.0927 #kPa
U2 = 1.83 #ms1
Rn = 10.63 #MJ m-2 day-1
H = 213.4 #m
lat = 41 #N
```

1.2 What is your calculated G?

G is the ground heat flux messured in MJ m^{-1} day^{-1}

$$G = 4.2 * (T\ i + 1 - T\ i - 1)/Deltat$$

```
#Select Variables
Tbefore <- Tavg_Aug1
Tafter <- Tavg_Aug3
time <- 3 - 1

#Solution
G <- 4.2 * ((Tbefore - Tafter)/time)

print(paste("The ground heat flux is",G,"MJ m-1 day-1"), quote = FALSE)
```

```
## [1] The ground heat flux is -11.76 MJ m-1 day-1
```

1.3 What is your calculated Lambda?

Lambda is the latent heat of vaporization in MJ kg^{-1}, where T is average temperature (I assumed of the 3 days)

$$Lambda = 2.501 - 2361 * 10^{-3} * T$$

```
#Data
AvgT <- mean(c(Tavg_Aug1,Tavg_Aug2,Tavg_Aug3))

#Solution
Lambda <- round(2.501 - 2361* 10^{-3} * AvgT,2)

print(paste("The latent heat of vaporization is",Lambda,"MJ kg-1"), quote = FALSE)
```

```
## [1] The latent heat of vaporization is -40.15 MJ kg-1
```

1.3 What is your calculated P?

P is atmospheric pressure measure in kPA, H is the elevation above sea level in meters.

$$P = 101.3 - 0.01055H$$

```
#Data
H <- H #elevation above sea level

#Solution
P <- round(101.3 - 0.01055 * H,2)

print(paste("The atmospheric pressure is",P,"Kpa"), quote=FALSE)
```

```
## [1] The atmospheric pressure is 99.05 Kpa
```

1.4 What is your calculated Gamma?

Gamma is the pyschrometric constant measured in kPa C^{-1}, cp is the specific heat of water at constant pressure (0.001013 kJ kg-1 oC-1) and P is atmospheric pressure

$$Gamma = C\ p * P/0.622 * Lambda$$

```
#Data
CP <- 0.001013 #kg-1 oC-1
Lambda
```

```
## [1] -40.15
```

```
P
```

```
## [1] 99.05
```

```r
#Solution
Gamma <- round(CP * P / 0.622 * Lambda,2)

print(paste("The pyschrometric constant is",Gamma,"kPa C-1"), quote = FALSE)
```

```
## [1] The pyschrometric constant is -6.48 kPa C-1
```

1.5 What is your calculated Delta?

Delta is the slope of the saturation vapor pressure - temperature curve, mesured in kPa C^{-1}

$$Delta = 0.200(0.00738T + 0.8072)^7 - 0.00116$$

```r
#Data
#AvgT

#Solution
Delta= round(0.200 * (0.00738*AvgT + 0.8072)^7 - 0.00116,2)

print(paste("The slope of curve is",Delta,"kPa C-1"), quote=FALSE)
```

```
## [1] The slope of curve is 0.13 kPa C-1
```

1.6 What is your calculated PET?

PET is potential evapotranspiration in mm day^-1

```r
#Solution
#First Part of the equation

PET_1 <- Delta / (Delta + Gamma) * (Rn - G)
PET_2 <- Gamma/ (Delta + Gamma) * 6.43 * (1 + 0.53 * U2) * VPD

PET <- round((PET_1 + PET_2) / Lambda,2)

print(paste("The potential evapotranspiration is",PET,"mm per day"), quote=FALSE)
```

```
## [1] The potential evapotranspiration is -0.34 mm per day
```

2 - The Evaporation Pan