

Tutorial Session No. 1.

Exercise 1 :

Recall that the mean solar constant is $G_{sc}=1367 \text{ W/m}^2$. You are asked to calculate the value of the extraterrestrial solar flux for the days $n=30, 100$ and 200 . What do you observe?

Plot the evolution of G_{on} using an Excel software and discuss its variation over the year.

Exercise 2 :

For a specific region on Earth, the following data are available:

- Daily extraterrestrial irradiation: $H_0=38 \text{ MJ/m}^2$;
- Astronomical day length: $N=14.5 \text{ h}$;
- Actual sunshine duration: $n=9.5 \text{ h}$.

Given that the local empirical coefficients are $a=0.23$ and $b=0.50$, estimate the daily global irradiation H .

Exercise 3 :

A weather station reports an average cloud cover of **5/8 (in oktas)**. A local correlation is used:

$$K_t = H/H_0 = 0,75 - 0,06 \times \text{oktas}.$$

Estimate K_t .

1. For $H_0=32 \text{ MJ/m}^2$, calculate H .
2. Discuss the validity of this type of empirical relationship.

Exercise 4 :

We consider a location receiving an average of $5.2 \text{ kWh/m}^2/\text{day}$ of global solar radiation.

1. Estimate the annual solar energy per square meter.

2. What surface area of solar panels with an efficiency of 18% must be installed to produce 5000 kWh per year?

Exercise 5 :

A photovoltaic system with an area of $A = 20 \text{ m}^2$ is installed in a region where the annual solar irradiation is $1800 \text{ kWh/m}^2/\text{year}$. The system has the following characteristics:

- Nominal efficiency of the module: $\eta = 15\%$,
 - Overall losses (cables, inverter, temperature, dirt): 20%
1. Estimate the annual electrical energy produced.
 2. What would be the production if the losses were reduced to 10%?

Exercise 6 :

A pyranometer station measured, for a given month, an average daily irradiation of 21.5 MJ/m^2 . The Ångström–Prescott method, applied to the same meteorological data, gives $H = 22.8 \text{ MJ/m}^2$.

1. Calculate the relative error between the estimation and the measurement.
2. Discuss the possible causes of the observed difference.