Hydropower potential assessment made easy via the unit geo-hydro-energy index (EGU21-4462)

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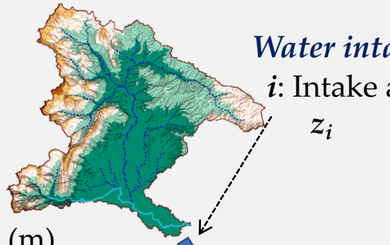
Schematic representation and definitions



Upstream catchment characteristics at site $I_i(x_i, y_i, z_i)$

A_i: Basin area (m^2)

Z_i: Mean elevation (m)

P_i: Mean annual precipitation (m)

R_i: Mean annual runoff (m)

Alternative sites for power house (energy production)

$j(i)$: Alternative sites (x_j, y_j) for turbine location downstream of intake I_i, with elevation z_j

Water intake (flow diversion)

i: Intake at site (x_i, y_i) with elevation z_i

Geometrical properties

D_{ij}: Euclidean distance from the intake i to the alternative sites j for energy production (m)

L_{ij}: Diversion distance along the river segment from the intake i to the alternative sites j for energy production (m) – by definition, $L_{ij} \geq D_{ij}$

h_{ij}: Altitude difference between the intake i and the alternative sites j for energy production (m), also referred to as **gross head**

- **Potential energy production**, on mean annual basis (hydraulic and energy losses are omitted, and all catchment's runoff is diverted to the turbines):

$$PE_{ij} = \gamma\, R_i\, A_i\, h_{ij}$$

γ is the specific weight of water (9.81 KN/m^3)

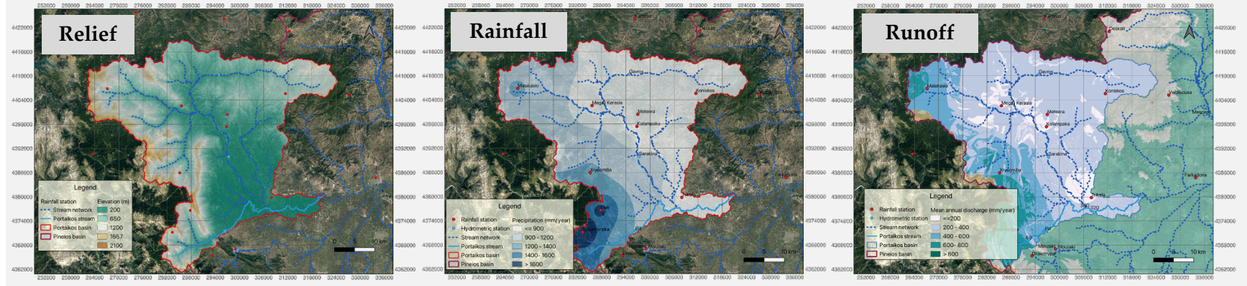
- **Unit potential energy production**, by considering a mean annual runoff equal to 1 m (1000 mm):

$$UPE_{ij} = \gamma\, A_i\, h_{ij}$$

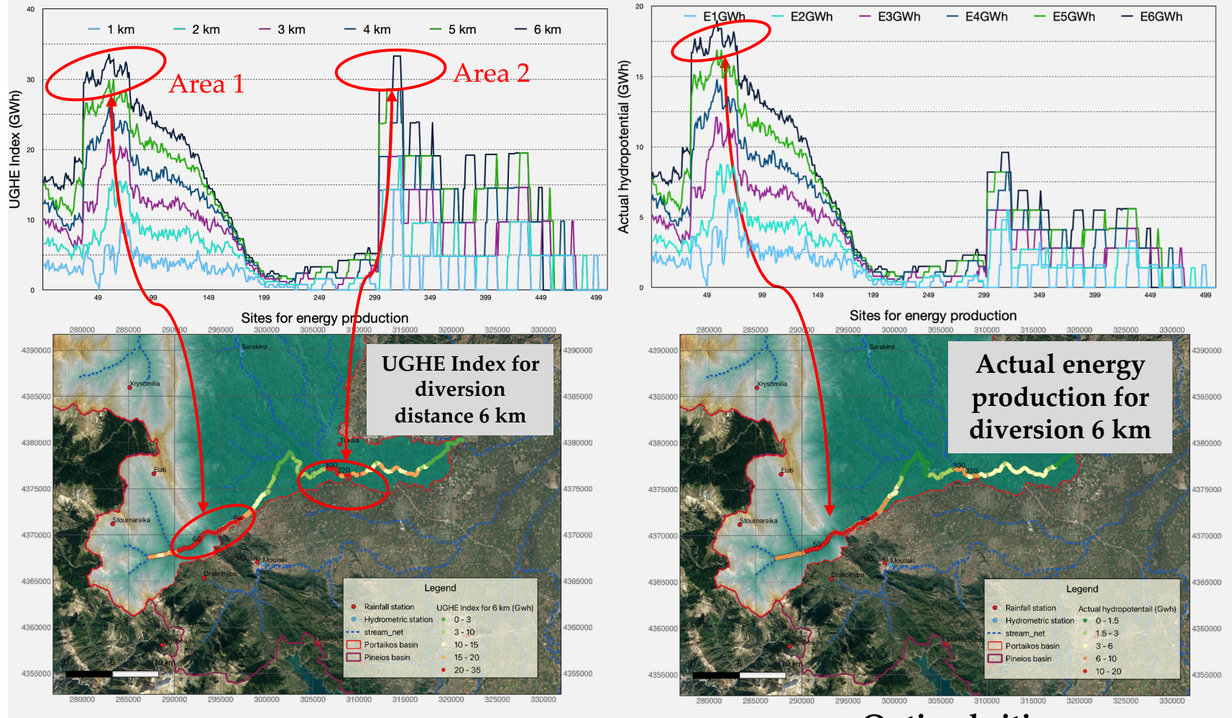
Software implementation

- The value of UPE_{ij} across a hydrographic network, where all intakes I_i are located at specific distances $L_{ij} = \Delta l$, is called **unit geo-hydro-energy index** (UGHE). Its purpose is to evaluate a hydroelectric development site through easy geomorphological information.

Area of interest: Upper Peneios basin, Greece



UGHE index & Potential energy production



Among the two promising areas, the potential energy is maximized where **the product of upstream area and actual runoff is maximized**

Optimal siting

- Head: 94 m
- Mean inflow: 84.3 hm3
- Hydropower potential: 18.4 GWh