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Hydropower potential assessment made easy via the unit geo-hydro-energy index

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The design of hydropower works typically follows a top-down approach, starting from a macroscopic screening of the broader region of interest, to select promising clusters for hydroelectric exploitation, based on easily retrievable information. Manual approaches are very laborious and may fail to detect sites of significant hydropower potential. In order to facilitate this kind of studies, we provide a novel geomorphological approach to assess the hydropower potential across river networks. The method is based on the discretization of the stream network into segments of equal length, thus providing a background layer of head differences between potential abstraction and power production sites. Next, at each abstraction point, we estimate the so-called unit geo-hydro-energy index (UGHE), which is a key concept of our approach. UGHE is defined as the ratio of annual potential energy divided by the upstream catchment area, the head difference, and the unit annual runoff of the catchment, which is set equal to 1000 mm. The method is further expanded, to estimate the actual hydropotential, if spatially distributed runoff data are available. All analyses are automatized by taking advantage of the high-level interpreted programming language Python and the open-source QGIS tool. The proposed framework is demonstrated at the regional scale, involving the siting of run-of-river hydroelectric works in the Peneios river basin.