

Characterization of the solar energy resource in urban environments by network theory

Keywords: Urban ecosystem; Solar energy resource; Spatial and Temporal distribution; Shannon index; Network theory

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Internship topic

By 2050, nearly 70% of the world's population will be concentrated in urban areas (ie nearly 6 billion people). Consequently, it is fundamental to characterize the urban ecosystem with the aim of guiding the energy and ecological transition strategies of these developing urban territories in order to guarantee their resilience. To this end, the knowledge and characterization of these systems, which must meet different functionalities (housing, access to resources - energy, water, food, etc. -, waste management, economic activity, education, administration, security, leisure, social integration ...), in interaction with the surrounding territories (near or far), is crucial.

The internship project will focus on the analysis of the solar resource in urban areas from existing solar cadasters. The (spatial and temporal) distribution of this energy resource will be represented using mapping tools, based on network theory, including the time dimension to explore how resources can be moved in time (e.g. energy storage) and the space dimension to evaluate resources sharing opportunities over the territory. The analysis of the resulting spatial and temporal distributions of energy flows on the territory will be carried out using the evaluation of the Shannon index, making it possible to characterize the variabilities from the estimated distribution laws. This indicator, which will be assessed at different scales, will make it possible to characterize the disparities in access to solar energy in the studied territory. Correlated to the assessment of energy needs in the territory, the intra- and extra-urban interdependencies of the urban territory can be highlighted.

This work aims to be continued in PhD thesis by extending to the analysis of local energy needs and available resources (by dissociating imported energies and diffuse energies on the territory - outside temperature, solar energy, geothermal, aquathermal, waste heat) at the scale of the urban territory.

Workplan

- State of the art on solar cadasters and the application of network theory on urban territories
- Appropriation of the solar cadaster tool
- Characterization of local disparities/variabilities (spatial and temporal) and their influences at the global scale of the city
- Assessment of intra- and extra-urban interdependencies

Required profile

The candidate must have strong skills in advanced thermodynamics and statistical database analysis, with a great scientific openness and a strong interest in collaborative work.