Geophysical Research Abstracts
Vol. 20, EGU2018-15229-1, 2018
EGU General Assembly 2018

Modelling of solar energy potential in urban areas from a local to a global scale

Nahid Mohajeri (1), Dan Assouline (2), Agust Gudmundsson (3), and Jean Louis Scartezzini (2)

(1) Department for Continuing Education, University of Oxford, Rewley House, 1 Wellington Square, Oxford OX12JA, United Kingdom, (2) Solar Energy and Building Physics Laboratory (LESO-PB), Ecole Polytechnique Fédérale de Lausanne (EPFL), 1015 Lausanne, Switzerland, (3) Department of Earth Sciences, Royal Holloway University of London, Egham TW20 0EX, United Kingdom

Distributed Energy Systems (DES) provides a new approach as to how energy is produced, delivered, and consumed. Distributed power generation through photovoltaics (PVs) is widely regarded as contributing favourably to environmental, economic, and social aspects of urban sustainability. Considerable part of the PV electricity production in the future is likely to be urban-based. This is partly because towns and cities provide areas, namely rooftops and facades as well as street surfaces, for PV installations. Cumulatively, these areas are very extensive – and considerable areas are needed to make solar energy the main electricity source - and mostly not used for other purposes.

There have been many studies in recent years on estimating the photovoltaic solar energy potential from the scale of individual buildings and neighbourhoods (local scale), to the scales of entire cities and countries (national scale). Methods used for estimating the potential of PV on a local and national scale include (i) simulations, (ii) sampling techniques, (iii) GIS-based Feature Analyst (FA) tools, (iv) statistical methods, (v) aerial images, (vi) ArcGIS together with LiDAR (Light Detection and Ranging) data, and recently (vii) a machine-learning methods. We have applied several of these methods to estimate the solar PV potential for building facades and roofs as well as for street surfaces at the local and national scale for Switzerland. More specifically, to estimate the photovoltaic solar energy potential on building roofs we use a combination of data-driven methods including machine-learning algorithms and GIS. We use ArcGIS together with LiDAR (Light Detection and Ranging) data to estimate the photovoltaic solar energy potential on building roofs and facades at neighbourhood and city scale. For street surfaces, we use ArcGIS at city scale to estimate the solar energy potential. The results show strong effects of urban configuration (orientation of buildings and streets, building height/street width (aspect) ratios, geometries and orientations of roofs, urban density, etc.) on the solar potential.

Here we show how the above modelling tools have been used to estimate the solar PV electricity production for buildings and streets at different scales in Switzerland. We provide the results of the technical assessment but also socio-economic aspects of PV-produced electricity supply for a sustainable urban development. We suggest that solar energy technologies and associated socio-economic assessment should evolve together, and indicate how their co-evolution may affect sustainable urban development and energy policies.

N Mohajeri, G Upadhyay, A Gudmundsson, D Assouline, J Kämpf, JL Scartezzini, 2016. Effects of urban compactness on solar energy potential. Renewable Energy 93, 469-482

D Assouline, N Mohajeri, JL Scartezzini, 2017. Quantifying rooftop photovoltaic solar energy potential: A machine learning approach. Solar Energy 141, 278-296.

N Mohajeri, D Assouline, B Guiboud, A Bill, A Gudmundsson, JL Scartezzini, 2018. A city-scale roof shape classification using machine learning for solar energy applications. Renewable Energy https://doi.org/10.1016/j.renene.2017.12.096