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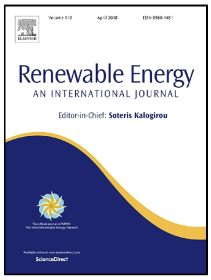

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Nahid Mohajeri, Dan Assouline, Berenice Guiboud, Andreas Bill, Agust Gudmundsson, Jean-Louis Scartezzini

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A city-scale roof shape classification using machine learning for solar energy applications

Nahid Mohajeri[a,b]*, Dan Assouline[a], Berenice Guiboud[a], Andreas Bill[a], Agust Gudmundsson[c], Jean-Louis Scartezzini[a]

[a]Solar Energy and Building Physics Laboratory (LESO-PB), Ecole Polytechnique Fédérale de Lausanne (EPFL), 1015 Lausanne, Switzerland, [b]Sustainable Urban Development Programme, Department for Continuing Education, University of Oxford, Rewley House, 1 Wellington Square, Oxford OX1 2JA, United Kingdom. *Corresponding author; e-mails: nahid.mohajeri@epfl.ch; nahid.mohajeri@conted.ox.ac.uk

[c] Department of Earth Sciences, Royal Holloway University of London, Egham TW20 0EX, United Kingdom

Abstract

Solar energy deployment through PV installations in urban areas depends strongly on the shape, size, and orientation of available roofs. Here we use a machine learning approach, Support Vector Machine (SVM) classification, to classify 10,085 building roofs in relation to their received solar energy in the city of Geneva in Switzerland. The SVM correctly identifies six types of roof shapes in 66% of cases, that is, flat & shed, gable, hip, gambrel & mansard, cross/corner gable & hip, and complex roofs. We classify the roofs based on their useful area for PV installations and potential for receiving solar energy. For most roof shapes, the ratio between useful roof area and building footprint area is close to one, suggesting that footprint is a good measure of useful PV roof area. The main exception is the gable where this ratio is 1.18. The flat and shed roofs have the second highest useful roof area for PV (complex roof being the highest) and the highest PV potential (in GWh). By contrast, hip roof has the lowest PV potential. Solar roof-shape classification provides basic information for designing new buildings, retrofitting interventions on the building roofs, and efficient solar integration on the roofs of buildings.

Keywords:
Machine learning; Roof shape classification; PV potential; Support Vector Machine

1. Introduction

Photovoltaics (PV) are among the most promising emerging technologies for deployment of solar energy in urban areas. Solar PV panels can be installed on the rooftops of individual