Geophysical Research Abstracts
Vol. 20, EGU2018-16275-2, 2018
EGU General Assembly 2018

A stochastic model for hourly solar radiation process applied in renewable resources management

Giannis Koudouris, Panayiotis Dimitriadis, Theano Iliopoulou, Georgios Karakatsanis, and Demetris Koutsoyiannis

Department of Water Resources and Environmental Engineering, National Technical University of Athens, Greece

Since the beginning of the 21st century, the scientific community has made huge leaps to exploit renewable energy sources, with solar radiation being one of the most important. However, the variability of solar radiation has a significant impact on solar energy conversion systems, such as in photovoltaic systems, characterized by a fast and non-linear response to incident solar radiation. The performance prediction of these systems is typically based on hourly or daily data because those are usually available at these time scales. The aim of this work is to investigate the stochastic nature and time evolution of the solar radiation process in a daily and hourly step on a monthly basis scale, with the ultimate goal of creating a stochastic model capable of generating hourly solar radiation. For this purpose, an analysis was initially made at stations in Greece and then on a global scale. We propose a distribution that can adequately describe daily solar radiation and a new distribution consisting of the sum of two known distribution functions that is capable of capturing all aspects of the hourly solar radiation. Also, we exploit the clear sky index coefficient (T) for the double periodicity of the process, so as to achieve an integrated framework for the description of the solar radiation at all scales. Also, we use statistical tests and selection criteria, in order to verify the goodness of fit of the selected distribution. Then, we propose a cyclostationary model that can handle long-term persistence and reproduce the clear sky index coefficient (KT). The model can preserve the probability density function and also the dependence structure. Finally, we apply the proposed stochastic model to a theoretical case of renewable energy management, with an ultimate goal to maximize the financial profit of the production system.
Acknowledgement: This research is conducted within the frame of the course "Stochastic Methods" at the School of Civil Engineering of the National Technical University of Athens (NTUA), Greece. The students, PhD candidates, Fellow Researchers, Post-Doc Researchers and Professors are struggling to deliver research results without any financial support.