Geophysical Research Abstracts
Vol. 15, EGU2013-11660, 2013
EGU General Assembly 2013

Stochastic analysis and simulation of hydrometeorological processes for optimizing hybrid renewable energy systems

Georgios Tsekouras, Christos Ioannou, Andreas Efstratiadis, and Demetris Koutsoyiannis
National Technical University of Athens, Civil Engineering, Greece

Stochastic analysis and simulation of hydrometeorological processes for optimizing hybrid renewable energy systems

Georgios Tsekouras, Christos Ioannou, Andreas Efstratiadis and Demetris Koutsoyiannis

Abstract
The drawbacks of conventional energy sources including their negative environmental impacts emphasize the need to integrate renewable energy sources into energy balance. However, the renewable sources strongly depend on time varying and uncertain hydrometeorological processes, including wind speed, sunshine duration and solar radiation. To study the design and management of hybrid energy systems we investigate the stochastic properties of these natural processes, including possible long-term persistence. We use wind speed and sunshine duration time series retrieved from a European database of daily records and we estimate representative values of the Hurst coefficient for both variables. We conduct simultaneous generation of synthetic time series of wind speed and sunshine duration, on yearly, monthly and daily scale. To this we use the Castalia software system which performs multivariate stochastic simulation. Using these time series as input, we perform stochastic simulation of an autonomous hypothetical hybrid renewable energy system and optimize its performance using genetic algorithms. For the system design we optimize the sizing of the system in order to satisfy the energy demand with high reliability also minimizing the cost. While the simulation scale is the daily, a simple method allows utilizing the subdaily distribution of the produced wind power. Various scenarios are assumed in order to examine the influence of input parameters, such as the Hurst coefficient, and design parameters such as the photovoltaic panel angle.