

Global atlas of solar and wind resources temporal complementarity

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Abstract

The concept of renewable energy sources complementarity has attracted the attention of researchers across the globe over recent years. Studies have been published regularly with focuses on aspects such as new metrics for complementarity assessment, the optimal operation of hybrid power systems based on variable renewables, or mapping resources complementarity in a specific region. This study targets the present literature gap, namely a lack of complementarity study covering explicitly the whole World, based on the same data source and methodology. The research employs Kendall's Tau correlation as the complementarity metric between global solar and wind resources and a pair of indicators such as the solar share and a sizing coefficient usually applied in the domain of hybrid generators. This method allows to conduct a preliminary estimation of a solar and wind energy hybrid generator based on a daily demand of 1 kWh. The data series employed in this study come from NASA's POWER Project Program, covering the years 2001–2020. This work provides an interesting insight into the global variability of the complementarity between these two variable energy sources. Significant findings of this paper include that Kendall's Tau ranges between -0.75 and 0.75 , in line with previous research for specific regions, thus providing a theoretical maximum for planning. Additionally, the results suggest that in most tropical and subtropical areas, the hybrid solar-wind generator should be dominated by the solar portion to minimize the variability of the total daily energy produced.

Keyword: Renewable energy, Variable renewables, Complementarity, Hybrid power systems