Return time statistic of wind power ramp events

Rudy Calif (1) and François G. Schmitt (2)

(1) Université des Antilles et de la Guyane, France (rcalif@univ-ag.fr), (2) CNRS, UMR 8187 LOG Laboratoire d'Océanologie et de Géosciences, Université de Lille 1, 28 avenue Foch, 62930 Wimereux, France

Detection and forecasting of wind power ramp events is a critical issue for the management of power generated by wind turbine and a cluster of wind turbines. The wind power ramp events occur suddenly with larges changes (increases or decreases) of wind power output. In this work, the statistic and the dynamic of wind power ramp events are examined.

For that, we analyze several datasets of wind power output with different sampling rate and duration. The data considered are delivered by five wind farms and two single turbines, located at different geographic locations. From these datasets, the return time series τ_r of wind power ramp events, i.e., the time between two successive ramps above a given threshold Δp. The return time statistic is investigated plotting the complementary cumulative distribution $C(\tau_r)$ in log-log representation. Using a robust method developed by Clauset et al., combining maximum-likelihood fitting methods with goodness-of-fit tests based on the Kolmogorov Smirnov statistic, we show a scaling behavior of the return time statistic, of the form:

$$C(\tau_r) \sim k\tau_r^{-\alpha}$$

where k is a positive constant and the exponent α called the tail exponent of the distribution. In this study, the value of α ranges from 1.68 to 2.20. This result is a potential information for the estimation risk of wind power generation based on the return time series.

References

[1] Clauset A, Shalizi CR, Newman MEJ. Power-Law distributions in empirical data. SIAM Review 2009;51(4):661-703.