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Title: Forecasting offshore wind energy: non-linearity, non-stationarity and varying bounds

Abstract:
Forecasting is of the utmost importance to the integration of renewable energy into power systems. We focus on offshore wind power short-term forecasting, as wind power fluctuations at horizons of a few minutes ahead particularly affect the system balance and are the most significant offshore. Those very short-term lead times are not only crucial but also the most difficult to improve the forecasts for.

For short-term forecasting, statistical methods have proved to be more skilled and accurate. However, they often rely on stationary, Gaussian distributions, which are not appropriate for wind power generation. Indeed, it is a non-linear, non-stationary stochastic process that is double bounded by nature. We extend previous works on generalized logit-normal distributions for wind energy by developing a rigorous statistical framework to estimate the full parameter vector of the distribution. To deal with non-stationarity, we derive the corresponding recursive maximum likelihood estimation and propose an algorithm that can track the parameters over time.

From the observation that bounds are always assumed to be fixed when dealing with bounded distributions, which may not be appropriate for wind power generation, we develop a new statistical framework where the upper bound can vary without being observed. In the context of stochastic processes, we address the bound as an additional parameter and propose an online algorithm that can deal with quasiconvexity.