Forecast trajectories for the production of a renewable virtual power plant able to provide ancillary services

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The aggregation of multiple renewable plants located in distinct climate zones, using different energy sources, enables to reduce the production uncertainty when compared to the production of a single plant. Such aggregations, controlled by a Virtual Power Plant (VPP) system, are good candidates for the provision of ancillary services. Stochastic optimization models are available to optimize biddings on ancillary services and energy markets (see for instance [1]). These models require trajectories of the renewable VPP production that anticipate production uncertainty and reproduce correctly the temporal correlations observed in the production signal. This is particularly important in ancillary services markets, where a reserve bid must be guaranteed over a production duration or validity period during which power fluctuations are significant (e.g. lasting currently 24 hours on the European common market for Frequency Containment Reserve, with a foreseen evolution to 4 hours by July 2020 [2]).

Production trajectories may be obtained by coupling probabilistic forecasts and a model of temporal dependencies between forecast horizons [3] and possibly spatial dependencies in the case of a multivariate forecast at the scale of a region or a portfolio [4]. In the case of a renewable VPP, the aggregated production is primarily of interest. In this work, we propose a methodology to generate trajectories of aggregated production from probabilistic forecasts obtained with decision-tree based models or neural networks. A copula models the dependency between forecast horizons and the space defined by the plants contained in the aggregation. The model is tested in a day-ahead forecasting configuration on a 54 MW VPP comprising 15 plants with 3 different energy sources (Photovoltaics, Wind, Hydro). The comparison of trajectories generated from a direct forecast of the aggregated production and from forecasts at lower levels of the aggregation shows that the latter solution reproduces with more accuracy the temporal variability of the aggregated production over the whole horizon range, especially when Photovoltaics dominates the production capacities in the aggregation (15 % improvement of the Variogram Score).