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Probabilistic short term wind power forecasts with using Deep Neural Networks with discrete target classes

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Usually, neural networks trained on historical yield time series of wind turbines deterministically predict power output over the next hours to days, by minimising a scalar cost function (often the RMSE error between network output and target values) on a validation data set. Yet similar to the analog ensemble (AnEn) method, the training algorithm can also be made to analyse the uncertainty of the power output from the spread of possible targets found in the historical data for a certain meteorological situation. In this study, the uncertainty estimate is achieved by discretising the continuous time series of power targets into several bins (classes). For each forecast horizon, a neural network then predicts the probability of power output falling into each of the bins. The resulting empirical probability distribution can then be analysed to determine percentiles or statistical moments. Similiar to the AnEn method, the advantage of the proposed method is that it avoids the use of costly NWP ensemble runs, although a selection of several deterministic NWP forecasts as input is helpful. We demonstrate the application of this new method in case studies for a large region and a single wind farm using state-of-the-art deep learning technology, and analyse the results in terms of skill scores and a comparison to deterministic forecasts.