Masterthesis: Improving the lidar-based prediction of ramp using LES and a lidar simulator

Scope:
With the increasing share of renewables in today's energy system, minute-scale wind speed and power forecasts are gaining importance. Not only do they support a smoother grid integration of strongly fluctuating renewable energy, but also hold significant value for electricity trading purposes. Of particular importance is the detection and accurate prediction of strong and sudden changes of wind speed/direction that can cause strong gradients in the feed-in of offshore wind farms. Commonly, statistical models are used for minute-scale forecasting, however, they fail during such ramp events. Recently, remote sensing-based power forecast have been increasingly researched and proven to be valuable for minute-scale forecasting. To optimize the prediction of ramp events, Large Eddy Simulations (LES) in combination with a lidar simulator are useful as they allow to test different measurement set-ups, lidar trajectories and forecasting approaches under the same conditions. This master thesis analyses simulated ramp events at the offshore wind farm Nordergründe. Aim of this work is to implement and test different minute-scale forecasting methodologies, e.g. by varying long-range lidar trajectories, to predict ramp events using a lidar simulator. The forecast skill for the different approaches will be evaluated.

Work steps:
- Literature review
- Familiarization with LES and lidar simulator
- Preparation of LES netcdf-files for lidar simulator
- Characterization of simulated ramp events and validation with SCADA data
- Implementation of different lidar trajectories/forecasting methodologies for minute-scale forecasting in LES
- Evaluation of different forecasting approaches/lidar trajectories, comparison to LES and SCADA data
- Analysis, interpretation and documentation of the results

Requirements:
- Very good programming skills in either Python or Matlab
- Basic knowledge and high interest in meteorology, lidar and LES
- Basic skills in data analysis

Start	asap
Duration	six months (full time)
Place	ForWind Oldenburg (W33)
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