Master thesis

The impact of porous windbreaks on the power output of wind turbines – an LES study

Wind turbines in a cultivated area sheltered by windbreaks (http://photogallery.nrcs.usda.gov/index.asp)

The picture above shows a common landscape e.g. in Central Europe: a cultivated area sheltered by windbreaks (e.g. hedges, rows of trees). A recent wind tunnel study by Tobin et al. (2017, Boundary-Layer Meteorology, DOI 10.1007/s10546-016-0228-8) indicated that it might be possible to increase the power output and to decrease the loads on wind turbines by applying porous windbreaks upstream of the turbines. This could be promising for the wind industry when it comes to installing new turbines or increasing the efficiency of already installed ones. **In the suggested study, the impact of porous windbreaks on wind turbines should be investigated extensively by a numerical parameter study with the large-eddy simulation model PALM** (Maronga et al., 2015, Geosci. Model Dev., 8, 2515–2551, doi:10.5194/gmd-8-2515-2015). First, it needs to be verified that the canopy model implemented in PALM can be applied to account for porous windbreaks in the simulation. Next, simulations for setups like that in Tobin et al. (2017) shall be carried out, i.e. the impact of a windbreak that has an infinite extension in crosswind direction shall be studied and compared with the results of Tobin et al. (2017). Coming to more realistic setups, the impact of windbreaks with limited crosswind extension on a wind turbine situated downstream shall be investigated. A sensitivity analysis will follow, in which e.g. the height of the wind break, the position of the wind turbine downstream of the windbreak or the atmospheric stratification are modified. **Questions such as what is the optimal distance of a windbreak to the turbine to optimize the power output shall be answered.** If time allows, the impact of windbreaks on the power output of wind farms shall be studied. **How does the power output of a wind turbine in the wake of an upstream wind turbine change due to the windbreak upstream of the first turbine? How large (if any) is the benefit from additional windbreaks inside the wind farm?**

Requirements: 1. Bachelor degree in meteorology, physics, engineering physics or a related subject and interest in wind energy 2. Basic knowledge in CFD modelling 3. Good knowledge in programming (e.g. C++ or Fortran)	**Begin:** as soon as possible **Duration:** 6 months (a preparatory internship of 2-3 months in the group is highly recommended if you are not yet familiar with PALM) **Contact:** Dr. Gerald Steinfeld ForWind – University of Oldenburg +49 (0) 441 798 5073 gerald.steinfeld@uni-oldenburg.de