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Quality assurance methods for models used in wind energy assessment

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Due to the reliance on numerical models for the economic analysis of wind energy projects a research program is being developed in the European Union to increase the confidence level of modeled results. The overall objective of this program, WAUDIT, is to improve measurement and modeling techniques to reduce uncertainties in power output predictions used in wind resource assessment. Within the WAUDIT project the task assigned to the Meteorological Institute at the University of Hamburg is to develop procedures for validating models used in wind energy assessment. The intent is not to evaluate and rank individual models, but to work simultaneously with modelers and develop a consensus to establish quality assurance methods to be utilized in wind energy assessment.

Literature shows a large range of power output predictability, with under and over prediction, from blind comparisons of numerical simulations with both field and wind tunnel test data. Therefore, standardized procedures for quality assurance need to be developed for the numerical modeling in wind energy applications to improve power output calculations. Numerical models undergo verification and validation procedures by the developers to determine the reliability of the results. However, each modeler utilizes a different procedure for this evaluation process, and has access to different datasets for validation. To improve the results obtained from wind energy models a database of quality checked experimental data, from physical models and field data, must be accessible to numerical modelers.

The adaptation of quality assurance methods for use in wind energy assessment modeling is difficult due to the different scales and modeled output variables required. Due to the scale differences, 10m up to more than 100km, different types of models are used based on the application of the modeled results. The first type, wind flow models are the first assessment tool used to determine the economic viability of wind energy at a specific location. These are microscale models that predict mean wind flow patterns to determine the potential wind energy extraction for a given location. The second are wake models, these are the small scale fluid mechanics models used to investigate the flow behavior behind a wind turbine (wake), and the interaction of the turbine wakes in wind farm situations.

The objective is for methods to be developed that provide guidance and outline quality check procedures for modelers to ensure consistency and improve the modeled results. Due to the different scales being modeled, varying model applications and computational advancements in CFD several types of models are implemented. It is expected that each type of model will require a separate validation procedure, however to start a general procedure with purposed validation metrics will be developed. The work to be presented will focus on motivation and an initial outline of the development of quality assurance methods specific to modeling in wind energy applications. Additionally, suggestions will be given for the validations metrics to be evaluated.