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Quantification and reduction of uncertainty in the wind resource assessment workflow through design of experiments and higher fidelity flow modeling

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Although ever improving, wind resource assessment (WRA) continues to be fraught with uncertainties and approximations, with developers and financial institutions continuing to demand more accurate WRA assessments to better qualify the business case certainty of wind projects. To meet these needs, Envision Energy has developed the Greenwich cloud platform to ensure the economic indicators of wind power assets and investments, provide developers with comprehensive technological solutions to wind farm planning, wind resource assessment, micro-siting, layout optimization, assessment of economic viability and post asset evaluation analysis. With its digital model structure, the Greenwich cloud platform controls and lowers risk arising from investment in wind farms, thereby significantly reducing the uncertainties of investing in wind energy. The primary engine of Greenwich is the GWCFD computational fluid dynamics (CFD) code, which is a fully automated CFD model leveraging the top super computing resources in the world. As it's workhorse, GWCFD employs the standard steady state RANS neutral approach to CFD wind modelling. Despite widespread industry acceptance, the neutral approximation can be quite limited, in particular in areas where local site climatology is dominated by strong influences of atmospheric stratification. This work will demonstrate Envision Energy's implementation of a stratified CFD modelling approach representing the entire atmospheric boundary layer, rather than the more common, but limited, atmospheric surface layer approaches. In addition, we will examine a proposed approach to aggregate neutral and stratified CFD simulations into an effective wind field for AEP estimations, and compare results to operational wind farm data as part of our ongoing internal AEP benchmarking studies. In order to quantify the improvements of various scientific upgrades to the WRA workflow, it is necessary to have an evaluation system in place. To demonstrate this, we will discuss Envision's algorithm test-bed wrapped within an uncertainty quantification and bench-marking umbrella.

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