The 9th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2024
3–7 June 2024, Lisbon, Portugal

On the validation of large eddy simulation of a wind-turbine array boundary layer

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Keywords: *LES, S3PQR models, boundary layer, wind turbine*

Direct numerical simulations of the incompressible Navier-Stokes equations at higher Reynolds numbers are not yet feasible, so dynamically less complex mathematical formulations such as Large Eddy Simulation (LES) have been developed. Over the years, there has been a cumulative improvement in the proposal and design of the models. New ones (namely S3PQR) have been prescribed using the first three principal invariants of the symmetric tensor $\mathsf{G}\mathsf{G}^T$ with excellent results [1] in the channel flow and homogeneous isotropic turbulence cases.

Recently, these and other LES models have been also applied and compared on the free boundary layer case and over a fully developed boundary layer wind farm, using a simplified model of a wind turbine [2]. The S3PQR models have given an outstanding performance [3].

To ensure a complete validation of the S3PQR models, in this work, we run several tests changing the parameters of the algorithm, from coarser to finer resolution [4]. Then, we compare the results with those from a direct numerical simulation. To give a broad view, we test the boundary layer case, the one single turbine scheme, and a fully developed wind farm.

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