University of British Columbia

The Actuator Farm Model for LES of Wind Farm-Induced Atmospheric Gravity Waves and Farm-Farm Interaction

Response to Reviewer 2

Exec. S. Stipa - September 12, 2024

We would like to thank the reviewer for the time dedicated to revising the paper. We proceed with answering and clarifying, where possible, their comments.

Our response, denoted in black, is shown below, while the reviewer's comments are denoted in blue. Please refer to the track changes document for a detailed overview of the changes made to the manuscript.

The abstract mentions the introduction of a "new wall modeling approach" to ensure a correct shear stress profile, but it lacks specific details on the settings or implementation of this approach. Without further information, it's unclear how this wall modeling technique is configured or applied within the simulations. Further details in the main text would likely address these aspects and provide insight into the practical application of this new approach.

In trying to merge the requests from the two reviewers, we decided to move former Sect. 2.3, which explains a correction to a wall model based on the classic Monin and Obukhov (1954) similarity theory, and former Sect. 2.4, where such wall model correction is verified for precursor simulations, to appendices A and B, respectively. In fact, the presentation of what is more of a correction to classic wall modeling formulations than a new wall model itself is a minor finding of the present manuscript. Notably, we highlight that a wall model correction when coarsening the grid goes hand in hand with the adoption of the AFM in more realistic cases where e.g. the time-varying inflow condition that characterizes the ABL is considered, as such grid coarsening is the basic motivation for which the AFM is employed in the first place. We also note that such discussion does not apply to more idealized cases such as e.g. simulations characterized by a uniform inflow.
The approach is now extensively documented in Appendix A and verified in Appendix B on the precursor simulations used throughout the manuscript. By moving these parts to appendices, we aim to focus the paper on the AFM, which is the main topic of the paper. Notably, we also removed from the abstract the sentence mentioned by the reviewer.

The paper would benefit from explicitly mentioning any additional requirements or considerations for using the proposed AFM model. For example, it should clarify whether specific conditions need to be met, such as ensuring that the center of the turbine is aligned with a grid point when using a very coarse resolution.

The suggested values for the parameters $r_{1/2}$, s and σ are summarized both in the isolated wind turbine section and in the conclusion. The analysis suggested by the reviewer (i.e. sensitivity of the AFM to turbine misalignment with the grid) has been performed on the coarsest grid resolution of 60×60 m and included in Appendix C of the revised manuscript. In particular, it is shown that shifting the turbine center relative to the grid results in power and thrust fluctuations which fall within 5% of the magnitude of the same variables. This is less than the fluctuations obtained when using poorly set model parameters $r_{1/2}$, s and σ, as shown in Fig. 4 of the revised manuscript. We hope this strengthens the paper in a manner that addresses the reviewer's comment

References

Monin, A. and Obukhov, A.: Basic laws of turbulent mixing in the surface layer of the atmosphere, Tr. Akad. Nauk SSSR Geophiz. Inst., 151, 163–187, 1954.