

Wind Energ. Sci. Discuss., referee comment RC2
<https://doi.org/10.5194/wes-2022-113-RC2>, 2023
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Comment on wes-2022-113

Anonymous Referee #2

Referee comment on "Lessons learned in coupling atmospheric models across scales for onshore and offshore wind energy" by Sue Ellen Haupt et al., Wind Energ. Sci. Discuss., <https://doi.org/10.5194/wes-2022-113-RC2>, 2023

General comments

The authors present the major findings that have been made by the Mesoscale to Microscale Coupling (MMC) team of the A2e initiative of the U.S. Department of Energy in the last couple of years.

Different approaches of coupling mesoscale and microscale models have been investigated by the team and applied to cases with step and step increasing complexity. One major achievement of the efforts made by the MMC team is the development of methods that help to overcome the long-standing problem of the terra incognita in atmospheric modelling. Moreover, the capabilities of several methods to ensure the development of turbulence in the microscale simulations coupled to the mesoscale ones are assessed.

A fast transfer of the knowledge gained by the MMC team to all modellers in the wind energy community as well as follow-up research by an even broader community is supported by the fact that the MMC team has made the simulation codes as well as pre-processing and postprocessing tools for several case studies publicly available on GitHub. Online documentation is also provided.

Summarizing, the paper presented by the members of MMC team is a great presentation of great work that will help to improve the modelling of wind resources and therefore support the further deployment of wind energy. I have only a couple of minor comments and therefore, I'm supporting the acceptance of the manuscript for publication in Wind Energy after minor revisions.

Specific comments

Line 49/50: „Thus, the solution to obtaining accurate flow prediction representing all relevant scales is to couple the models at these scales.“ What is meant by „these scales“ here?

Paragraph starting in line 52: My suggestion is to present the issues with coupling mesoscale and microscale models that are mentioned here in the form of a list with bullet points (similar to the list of objectives that is presented starting in line 69). Moreover, there could already be links made to those subsequent chapters where these issues are further addressed.

Line 51/52: Here, the problem of compressible mesoscale but incompressible microscale models is mentioned. Where is this problem later be addressed in the text?

Line 90: To make the contents of the paper accessible to a broad community the meaning of the terms offline and online in this context should be explained.

Line 101/102: To increase the clarity of subsequent descriptions I suggest to add „internal coupling“ in brackets at the end of the sentence starting in line 101.

Line 102/103: For the same purpose my suggestion is to add “external coupling” in brackets at the end of the sentence starting in line 102.

Line 122: presnts --> presents

Line 275: generate --> generated

Line 282/283: “the flow field within the fetch will not represent either the mean and turbulence fields during the process of turbulence spin-up and equilibration” Is this a specific problem of the spin-up time only? Close to the inflow boundary of the microscale domain (a region that I would understand as being in the fetch) even after the spin-up of turbulence these issues remain, don't they?

Line 352-354: Please add an information which of the two cases that are presented showed a larger sensitivity of the modelled flow on the eddy viscosity coefficient.

Line 369: atmophseric --> atmospheric

Line 391: How large are the fetch requirements? How strong is the fetch length requirement reduced in the case of applying a perturbation technique? What does the required fetch length depend on? Some quantitative statements would be valuable. Moreover, it would be interesting to suggest methods that help to assess whether the fetch length is sufficient or not.

General comment concerning chapters 3 and 4: My suggestion is to add also references to the papers from which results are presented in the titles of the subsections. To have that direct link would prevent that the reader needs to go back to chapter 2 to find that information.

Line 486: feature --> features

Line 614/615: „The larger extent allowed a fetch for turbulence development.“ What size of the fetch is required in order to get fully developed atmospheric turbulence?

Line 614: It would have been interesting to use the same horizontal extension of the model domain also for the SOWFA-IPA case in order to be able to exclude that the size of the model domain impacts the results obtained.

Figure 3: In addition to this figure, it would be interesting to show figures of the turbulence spectrum. How differently distributed is the turbulence energy in these different cases? How do the spectra change with position inside the domain?

Line 659: In order to be able to assess whether a domain with an extension of 6 km x 6 km provides a large fetch it would be helpful to provide an information on the fetch length that is actually required to get fully developed atmospheric turbulence.

Line 665: trubulence --> turbulence

Figure 5: The font (size and type) used in subparts a) and b) of this figure should be identical.

Figure 6: Please apply axis labels.

Line 683: My suggestion is to present the details on the different SST data sets used rather in a table instead of in the text.

Line 688: I think this is actually the first time that an information on the grid spacings applied is given. This would also be an interesting information for the other cases presented. This would mean a homogenization of the presentation of the different studies presented.

Line 731: Smagorsinky --> Smagorinsky

line 750: atmospheric boundary --> atmospheric boundary layer

Figure 10: What is the meaning of the shaded areas in this figure? Do all subfigures apply the same legend? In my opinion the figure showing the skin temperature can be deleted.

Figure 11: What is actually shown in the upper part of this figure and where is the reference in the text to this? What is the meaning of the third line presented in the subfigures in the bottom half of this figure?

Section 4.3: Please clarify: what is the temporal resolution of the 960 m resolution input field and the resulting GAN generated 30 m resolution field? Is the refinement of the data done in space and time? Or only in space? If the refinement is also done in time how well do the turbulence spectra agree with those of a full LES run?