



# ***Interactive comment on “Validation of a coupled atmospheric-aeroelastic model system for wind turbine power and load calculations” by Sonja Krüger et al.***

**Anonymous Referee #2**

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## **1 Overview**

The authors present an innovative for the numerical analysis of wind turbines, combining the modeling of the flow and the assessment of the performance of the machine. Based on its versatility, the authors suggest its use during the design stage, and also during the definition of a wind farm layout. The focus is put on the high fidelity modeling of the flow, based on a Large Eddy Simulation (LES) approach. The wind turbine model relies on an aeroelastic model, referred to as FAST. The coupling between the flow model and the wind turbine model relies on the efficient Actuator Sector Method

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(ASM). The authors first show the performance and capabilities of the aforementioned coupling, by means of a relative comparison with other approaches. This is done based on a reference wind turbine (i.e. the NREL 5MW). Finally, the authors include a validation of the approach, where the results of the developed methodology are compared with data acquired in an experimental campaign.

## 2 General comments

The major concerns of the reviewer have to do with the tone and the clarity of the paper. In particular:

- The methodology is not properly described, limiting the impact and reproducibility of the present research. Examples of these are:
  - PALM is only introduced as a “LES-tool”. No details about the solver/model are included, apart from the description of the mesh and the boundary conditions. Indeed, no figure of the flow solution is included in the manuscript.
  - FAST is introduced as an aeroelastic tool, but no details about the solver are given. The same comment applies for the FAST model used for the present work.
  - The wind turbine used in the experimental campaign is not properly introduced. For instance “Eno” is not introduced. Is it a wind turbine manufacturer?
  - The developed methodology is presented as a higher fidelity approach, with respect to other techniques (such as RANS for the flow modeling, or the actuator line for the coupling). However, the assumptions and limitations of the proposed methodology are not put into context. For instance, no mention

of rotor-resolved simulations is made in the introduction. In that context, the reviewer is interested in the limitations of the “frozen” windfield (could that compromise the accuracy of the method for particular situations?). However, this issue does not seem to be discussed in the paper.

- Is the ASM approach developed within the framework of the present work?
  - Line 164: The authors could give more details around the simulated case (such as omega and pitch).
  - Figure 5 could contain more info (such as the relative distance between the wind turbines).
  - No details about the controller are given.
- While the manuscript is significantly long, the discussion on the results is often very vague. Examples of these are:
    - Figure 3: A discussion of a longer time series, based on statistics/frequency domain, would be necessary before concluding on the capabilities of the method.
    - Figure 7: One could also quantify these differences, rather than only providing a qualitative statement.
    - Line 407: Discussions around the effect of the wind turbine controller seem to be vague. Could this issue be overcome by a re-tuning of the employed FAST controller?

From the reviewer perspective, the methodology followed to illustrate the performance of the method is insufficient. The comparison exercise around the NREL 5MW is limited to the integrated loads of a very particular case, and a rather poor analysis of a very short time series. It should be emphasized that, contrary to the title of the section, that comparison cannot be classified as a validation (since no experimental results were

considered). The reviewer also misses the presence of the other studied methods in Section 3.2. That could be particularly relevant, given the amount of uncertainty of the comparison itself.

### 3 Technical corrections

- Line 37: “There are different ways to model a turbine, as can be seen in ...” -> Maybe this sentence could be more clear, by replacing by something along the lines “to model the presence of the wind turbine in the flow”.
- Line 55: “Computing routine” could be replaced by something more precise, for instance “computing framework”.
- Line 153: would be more readable if references were grouped (cite{ref1,ref2,ref3}).
- Line 172: “coincides with the expected value” -> “with the value computed by NREL, based on the same FAST model?”
- Line 411: “Turbine answer” -> “turbine response”

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