Review of revisions https://wes.copernicus.org/preprints/wes-2023-75/

The Multi-Scale Coupled Model: a New Framework Capturing Wind Farm-Atmosphere Interaction and Global Blockage Effects

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Thank you for responding to my first comments. Generally happy with the corrections, except for some remaining fundamental questions I have below.

When looking at the new Figure 9 and revisions associated with it, I am a bit uncomfortable about the justification of running the wake model with mirroring of the turbines when using it within the MSC, yet needing to run it without mirroring when used outside of the MSC framework. I feel that this raises some fundamental questions and demands some justification based on the physics, and what the mirroring is supposed to represent, rather than, just based on the agreement each sub-option gets wrt the LES.

Did you question this? Do you have some potential explanation?

Also looking at Figure 15 again, I realise that the VC model used to model blockage hardly does anything to the result. And I think this is to be thought about in conjunction with the earlier question.

Both these things brought the following thoughts/doubts:

- I believe that the VC model for blockage, as implemented, does not satisfy mass conservation at the wind farm level. Is that right? I expect that if it did (like for example the RHB with wake expansion does), the model would produce a larger magnitude of blockage and create some background acceleration through the wind farm. The results from e.g. wake + RHB-W would be more different from wake results than your wake + VC currently are. If this were the case, you probably would not mind using it with a wake model also implementing the turbine mirroring, as without it, the combined wake + blockage would overpredict the power at the back of the wind farm. You would perhaps think that it's an issue if the wake model on its own no longer captures the power down the line of turbines when operating standalone. But if the wake model is meant to be used in conjunction with a blockage model, it should be validated against pattern of production when used in conjunction with the blockage model anyway, so this is not necessarily an issue*. Any thoughts?

- Am I right in thinking that the pressure perturbation derived from the 3LM model is not just the feedback from gravity waves, but indeed also accounts for mass conservation at the wind farm level? After all the ABL displacement which comes in equation 5 is very much the result of mass conservation across the layers. If so, does this raise the question as to whether the MSC framework requires a model for wind farm blockage at all, superposing individual turbine inductions? Would you not be double accounting if you were using the 3LM with a blockage model that does a better job at enforcing mass conservation? In fact, how do the MSC results compare with the LES if you don't used the VC model? Based on the little effect the VC model has when used with the wake model, I suspect that MSC results without it would not change much.

Can you please spare some thoughts about the above and amend the paper with what you conclude on this? The main question to address really is whether the MSC should actually be run with a blockage model at all.

* If a make model is to be used together with a blockage correction model (rather than iteratively coupled with a blockage model superposition induction/enforcing mass conservation at the wind farm level), based on leading row correction applied to the wind farm as a whole, then of course, such a model should still capture the pattern of production when operating on its own.