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WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Offshore and onshore ground-generation airborne wind energy power curve characterization" *by* Markus Sommerfeld et al.

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Response to referee 2 wes-2020-120

Markus Sommerfeld

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1 Author response

Dear referee 2, Thank you very much for your helpful comments to our manuscript, "Offshore and onshore ground-generation airborne wind energy power curve characterization", wes-2020-120. Please accept my apologies for the delayed response.

A lot of time was spend on the revision of this paper including re-clustering WRF wind data, re-running optimizations, re-evaluating results and re-writing major sections of this manuscript. We added a reference section which compares optimization results to quasi steady-state (QSS) AWES and WT reference models. We agree with the criticism to the AWES power coefficient and removed it. Instead, we implemented a brief description and investigation using the harvesting factor **?**. Please find detailed responses below. I am looking forward to your comments to further improve this paper.

Sincerely, Markus Sommerfeld

2 Specific comments

Line 5 "A universal" instead of "An ..."

- implemented

Line 8 annual energy prediction (AEP) → production

- implemented

Line 249 I'm curious about how pressure & density vary with stable vs. unstable conditions and how much that affects power.

- That would be interesting to investigate, but was deemed out of scope for this analysis. I would expect the impact on power to be rather small.

Line 271 Why is a reel-out to reel-in ratio used? Is this a combination of a motor torque constraint and the lift during reel-in and reel-out?

- This was a design choice based on conversations with a ground station developer. Motor torque is limited by tether tension.

Line 279 Assumed lift and drag on reel-in and reel-out should be included here

- It is hard to a priori estimate lift and drag as it highly depends on angle of attack, side slip angle and tether drag. Therefore, I would refer to figure 9 which summarizes representative lift, drag and pitch moment coefficients.

Line 280 Was a power constraint used? It's implied in other places.

- Power was indirectly limited by tether speed and tension constraints.

Line 357 I'd address elevation angle here; based on figure 10, it looks like the optimizer found a common optimal elevation angle for several of the cases, which links tether length and altitude. Vander Lind 2013 calculated an optimal elevation angle for flygensystems assuming an exponential wind profile; I'm curious how close this elevation angle is.

- Brief elevation angle analysis added.

Line 398 Missing U^3?

- implemented

Line 440 l_{path} and A_{swept} aren't in table 3

- section removed

Line 459 The fit for cp is a function of c_{wing} (and because AR is constant, a function of A_{swept}) so it's not non-dimensional and it's not clear how generalizable it is (changes in AR or L/D). I'm curious about whether another definition of cp may also be comparable to conventional wind turbines but work better. The Loyd paper (see eqs. 1 and 16) shows a limit on a cp ($4/27CL^3/CD^2$) defined by wing area. What does your data show for a cp defined by A_{wing}? Or if you express cp as a function of L/D orCL^3/CD^2?

- section removed