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Interactive comment on "Ground-generation airborne wind energy design space exploration" *by* Markus Sommerfeld et al.

Anonymous Referee #3

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General =======

The paper addresses effects on the scaling-up of AWES. This is a timely and important topic in the field.

WES Criteria ============

1. Does the paper address relevant scientific questions within the scope of WES?

Yes.

2. Does the paper present novel concepts, ideas, tools, or data?

Yes.

Printer-friendly version

Discussion paper

3. Is the paper of broad international interest?

Yes.

4. Are clear objectives and/or hypotheses put forward?

This can clearly be improved. In the introduction, the authors can better highlight what the main hypothesis is (one paragraph) and what the contributions of this paper are (one paragraph).

5. Are the scientific methods valid and clear outlined to be reproduced?

In principle, reproduction is complex but should be possible.

6. Are analyses and assumptions valid?

Yes (see questions/discussions below).

7. Are the presented results sufficient to support the interpretations and associated discussion?

Yes (see questions/discussions below).

8. Is the discussion relevant and backed up?

Yes (see questions/discussions below).

9. Are accurate conclusions reached based on the presented results and discussion?

Yes (see questions/discussions below).

10. Do the authors give proper credit to related and relevant work and clearly indicate their own original contribution?

Yes.

11. Does the title clearly reflect the contents of the paper and is it informative?

The authors may consider changing the title e.g. to "Scaling effects of rigid kite ground-

generation airborne wind energy".

12. Does the abstract provide a concise and complete summary, including quantitative results?

Yes (with the same limitations as discussed above and below).

13. Is the overall presentation well structured?

Yes.

14. Is the paper written concisely and to the point?

Yes.

15. Is the language fluent, precise, and grammatically correct?

Yes (some improvements given below).

16. Are the figures and tables useful and all necessary?

Yes.

17. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used according to the author guidelines?

Yes.

18. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

No.

19. Are the number and quality of references appropriate?

Yes.

20. Is the amount and quality of supplementary material appropriate and of added value?

Yes.

Questions/Discussions ==========

Figure 3: Do these curves originate from CFDs or wind tunnel tests? From the text it sounds like the characteristic is constructed/guessed "by hand" (also indicated by the unrealistically high negative lift coefficients). – It is important to have solid aerodynamic characteristics as the sensitivity of those on the power/energy/economics is high. If the curves in Fig. 3 are polynomial simplifications based on CFDs/wind tunnel data, please plot that original data also into the graphs.

Line 230: Angle of attack and thus lift coefficient seems to increase with the wind speed. This is unexpected to me. I'd rather expect the either the exact opposite to limit loads at high wind, or that the angle of attack remains mainly constant for all wind speeds during reel-out. Can you explain why the lift is changed so much? Can you also plot the apparent airspeed of the aircraft?

Line 259: Weight is neglected -> please clarify; the text before explains how it is accounted for

Table 1: Where does the value for d_tether originate from? Should it not be left to the optimizer to find the optimal value (given the constraint that a lower tether diameter limits F_tetherˆmax)? Also, it could have been left to the optimizer to find the optimal rated wind speed.

Line 347: This is likely caused by outliers, or wind velocity profile specific local minima -> In the paper, this is often said. How much trust can a reader give to the results, not knowing if it is a local or global minimum? (Would it be worth using simulation models and algorithms which can find the global optimum like swarm-optimization algorithms?)

Line 452: However, operating heights beyond 500 m are rare and mostly occur as the system de-powers above rated wind speed to stay within tether force and flight speed constraints. -> Is it possible and meaningful to keep the maximum tether length and

operating altitude below those values to reduce costs and permitting burdens?

Minors ======

Line 12: we estimate a minimum average cycle-average lift to weight ratio -> we estimate a minimum cycle-average lift to weight ratio (?)

Line 21: This study focuses on the two-phase, ground-generation concept -> You might consider a full stop there and delete everything until end of line 25. No need to list (apparent) drawbacks of drag power.

Line 35: re-power decommissioned offshore wind farms or deploy floating platforms -> is this correct? source?

Line 66: for for

Line 135: If the coefficients are meant not for the 2D airfoil, you may consider using capital letter C instead of lower case c. Note that C_L/C_D and C_Lˆ3/C_Dˆ2 has only a meaning for untethered flight or if C_D is for aircraft+tether.

Line 165: to reduce the mechanical wing load -> to limit ... (question: why not imposing a constraint on the wing loading directly instead?)

Line 168: but implemented as tether speed, acceleration constraints -> but implemented as tether speed and acceleration constraints (?)

Line 187: Results -> Results and Discussion (?)

Line 200: However, ... -> please double-check language

Line 202: Consider replacing the phrase "It is striking"

Line 204: with in -> within (?)

Line 222: it's -> its (double-check entire paper for this)

Line 237: in higher drag losses and -> in higher drag losses or

Line 237: the cosine loss due elevation angle is not caused by gravity (remove "gravity-caused")

Line 265: what is meant by "maximum cycle-average loads"? -> maximum load during a cycle?

Line 292: "only cut-in wind speed" seems lost

Line 335: lead result

Line 359: Determining ... determined

Line 370: power only scales with the wing area (F_lift âĹij bˆ2) -> note that the tether diameter and thus tether drag scale slower which is why power should scale faster than with bˆ2.

Line 427: sim -> \sim

Line 457: a elliptical lift distribution -> an elliptical lift distribution

Line 471: do can not produce

Line 495: offshore AWES are not particularly beneficial relative to conventional wind, given the generally lower sheer offshore -> Note that this is just another confirmation of the fact, that AWES advantage (at least for this concept), in particularly offshore, lies not in higher altitudes but reduced building material and associated benefits (transport etc.).

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