

## ***Interactive comment on “Characterization of flow recirculation zones in complex terrain using multi-lidar measurements” by Robert Menke et al.***

### **Anonymous Referee #2**

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This manuscript uses Doppler lidar observations collected over the complex terrain of Perdigao to provide a qualitative description of recirculation on the lee side of the ridges. Recirculation was mostly observed under periods of neutral and unstable stratification during measurement campaign. Recirculation was also observed during stable conditions, albeit less frequently. Authors has made an effort to analyze the occurrence of recirculation along three transects and during southwesterly and northwesterly winds. The results of this paper could be useful for wind turbine siting in complex terrain, as well as to assess the performance of wind solvers qualitatively. Therefore, I support the publication of this manuscript after a revision that addresses the following issues.

1) Based on the content of the manuscript and the extent of the analysis, “Qualitative

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characterization of flow recirculation zones in complex terrain using multi-lidar measurements” would be a more adequate title for the investigation presented.

2) Vertical profiles of wind speed and direction during certain periods are needed to enable computational researchers to simulate the problem. These profiles should be extracted from multiple locations such from ridgetops and inside the recirculation zone and provided as new figures along with corresponding Richardson number.

3) Page 1 Line 15. The introduction to wind turbine siting is out of date (e.g. the cited reference is from 1989) and does not reflect the latest best practices. The discussion needs to be updated to reflect the current state of the art in this area.

4) Page 2 Line 5: Change “characterized” to “identified”. (i.e. flow recirculation can be identified ...)

5) Page 2 Line 5: Regarding authors’ discussion of the Kutter et al (2017). There is nothing unexpected about recirculation being “prevalent” during neutral or unstable conditions. If the hill or any obstruction is steep enough, the flow is expected to recirculate in the wake under those conditions. Therefore, instead of saying “Kutter et al. “find” recirculation prevalent during ...” authors could say: “for instance, recirculation was prevalent during neutral and unstable atmospheric conditions during the observational study of Kutter et al.

6) Page 2 Line 10: Recirculation was intermittent in the Askervein experiment and the focus of Askervein was not to study recirculating flows. It would be better to refer to those studies as complex terrain studies as opposed to recirculation studies.

7) There is no mention of the Bolund Hill experiment and related studies. Introduction section need to review those recent efforts since the Askervein case for completeness.

8) Figure 1: Please provide the dominant wind direction observed during the measurements and consider using a different marker for the wind turbine and refer to the Met Tower as Mast in the legend to be consistent with the text.

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- 9) Page 4, the paragraph section 3: Figure 1 should be redrawn to convey the information given in this paragraph about wind directions (i.e. the dominant wind directions should be overlaid on the figure).
- 10) Page 5: Include a subscript G to emphasize gradient Richardson number in Equation 1
- 11) Figure 2: Make it larger for researchers who may need to digitize it. Create labels for SW Ridge and NE Ridge on the graph for sake of convenience for the readers.
- 12) Figure 4: Mark SW and NE ridges with labels on the terrain. Provide the gradient Richardson number for this 10 min period.
- 13) Figure 5: Increase the intervals in the x-axis so that the reader can approximately extract the Ri values without needing to digitize the graph. The bin width information in the caption is not helpful.
- 14) Figure 5: It would be more useful to present Figure 5 per transect as done in Figure 6, but for the Ri number.
- 15) Page 8 line 5: The features that are mentioned might play a role in the non-existence of recirculation, but the word “infer” is too strong in my opinion. Without a more detailed analysis, these features are suspects at best and insufficient to infer any flow behavior.
- 16) Page 9 line 5: Similar concern as in 5). The manuscript conveys the occurrence of recirculation in neutral and unstable conditions as if it is an unexpected feature. Recirculation under those conditions for steep geometry or terrain are expected without any surprise. The more interesting finding would be recirculation under stable conditions, which is much more interesting. The discussion can be revised to describe observations and results that are expected and do not qualify as “findings”
- 17) Authors can be more precise in their use of the term “stable conditions. Stable conditions need to be categorized as weakly, moderately and strongly stable based on

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the Ri number at hand, and authors can then compare against other studies that has similar conditions under that categorization.

18) Authors are only relying on a generic categorization of stable conditions to explain the existence or non-existence of recirculation. Flow separation is highly dependent on the geometry. The current discussion fails to explain why recirculation exist or does not exist under stable conditions.

19) Conclusions: Provide the height for the 8 m/s wind speed.

20) Conclusions: Typo in the last sentence. "Should be made".

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-847>, 2018.

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