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Interactive comment on "The fence experiment — full-scale lidar-based shelter observations" *by* A. Peña et al.

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We are very thankful for your comments because they are very useful and positive. Here follows our response item by item. The response is given as: xxx— response —xxx

The strength of this paper is its reporting of measurements from a modern remote sensing system applied to a longstanding research problem of quantifying flow through and around porous obstacles, particularly fences and real (three dimensional) shelterbelts. Being a quasi-2-D study (analysis in vertical plane but quasi because of variation of wind direction perpendicular to the vertical plane), the contributions of this study to the literature on shelterbelt flow is limited, except the effects of thermal stratification. However, the evaluation of the WindScanner lidar system on the reasonably well-known

flow field around fences is a useful contribution – the title appropriately captures this feature. And the care exercised by the authors in characterizing and understanding the inflow conditions in section 4.2 is very commendable and serves as a model for other such studies.

xxx— We thank the reviewer for the general feedback on our manuscript. The reviewer also states that "the contributions of this study to the literature are limited". We cannot find many papers where detailed fence-induced wake data are provided, for different fence types, and inflow conditions. Particularly, the data can be used directly to perform flow model evaluation, which is rather difficult to do with the actual literature due to lack of information about the instruments, the setups, the accuracy of the data (or the data themselves), and the description of the inflow conditions (a really important issue that the reviewer is also aware of). For example, in Wilson (2004) the concern regarding the accuracy of the measurements is evident. With respect to the later study our experiment provides e.g. measurements at four levels up to the fence height (1 level in Wilson, 2004) and at 27 downwind positions (4 in Wilson, 2004) within the range x/h<10, which is the region where models have more difficulties to predict the shelter —xxx

Some specific comments: p. 7. "These three devices conform the WS": Do you mean "These three devices comprise the WS"?

xxx— Yes, comprise is definitely a better word and so we use it now in the revised version —xxx

p. 7. "The volume depends on the probe length of each lidar, which is considered to be twice the Rayleigh length zR. At the focused distances of 28 and 42 m, the lidars operate with zR = 0.67 and 1.52 m, respectively..." So are you implying that the volume is zR3 or (2zR)3 or something else? Please state the scanning volume in relation to the grid shown in Fig. 4.

xxx— We rephrased the sentences to give a more accurate description of the measurement volume —xxx

Fig. 1. It should be clearly stated whether this is figure is a result of measurements or numerical simulation associated with this experiment or a conceptual view of what the flow field is envisioned to be behind a generic shelter of height h. And, of particular importance, if this image was adopted from another publication appropriate credit should be given.

xxx— We now explicitly say what this figure is —xxx

The terminology of section 5.1 is confusing. The term "speed-up" suggests a definition of [U(z)-Uo(z)]/Uo(z), so that no change = a speed up of zero. But the caption of Fig. 7 defines speed-up as U(z)/Uo(z), which is more precisely defined as a wind speed ratio.

xxx— We agree with the reviewer and so we now revised all instances where we mention speed up and now wind-speed ratio is used when appropriate —xxx

Fig. 8. caption: To be fully clear, the words "color bar" could be added to the first sentence, to read: "Average speed-up {....} (color bar) behind the fence..." And here, as above, it seems that wind speed ratio should be used in place of speed up.

xxx— The suggestion is taken into account in the revised version —xxx

Fig. 8 caption states that the "Vectors indicate the magnitude and direction of the ensemble-averaged u-component". This is more precisely stated as the "...magnitude and sign of the ... u-component".

xxx— The suggestion is taken into account in the revised version —xxx

Figure 8 begs the question of what happens with v, the along-shelter component of the wind behind the shelter? No mention is made of v, which has important contributions to both mass conservation and practical "sheltering effects" such as protecting sensitive plants from damage or depositing snow. The along-shelter, v, component is quite strong near the fence for a solid fence as has been shown in the shelterbelt literature,

even for infinitely long fences. So it is inaccurate to state that the sheltering function is high if u is small but U is large. An example is p. 15 where the term "deepest shelter effect" is applied to the region of low u but where v and hence U might be large. Furthermore, v' contributes to turbulence that affects the u component as well.

xxx— We thought about showing both components (u and v) but, in the original submission, we decided to concentrate on the horizontal wind speed only. However, we now have both u and v components as we also think they provide additional information —xxx

The authors have missed an opportunity to make wider comparison of their work, particularly Figs. 9-12, with published results relating to shelterbelts. An example is the paper on measurements near fence of Wilson (2004) and papers cited therein on modeling of normal and oblique flow to barriers. While the flow fields for neutral stratification in the vicinity of fences and thick shelters have been more widely published, few measurements are available of the effects of thermal stratification. The range of z/L in his study is rather small, but the results are important nevertheless.

xxx— We agree with the reviewer. Comparison with shelter measurements from the literature is now provided in the Conclusion and Discussion section —xxx

In summary, the paper is a useful contribution in relation to addressing the measurement challenges of a modern wind field observing facility as revealed through measurements of a reasonably well-known flow field. Their results add modestly to the literature of flow fields in the vicinity of porous barriers, except the inclusion of thermal effects.

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