

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

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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.

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Some specific comments:

p. 7. “These three devices conform the WS”: Do you mean “These three devices comprise the WS”?

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  $zR^3$  or  $(2zR)^3$  or something else? Please state the scanning volume in relation to the grid shown in Fig. 4.

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.

The terminology of section 5.1 is confusing. The term “speed-up” suggests a definition of  $[U(z)-U_0(z)]/U_0(z)$ , so that no change = a speed up of zero. But the caption of Fig. 7 defines speed-up as  $U(z)/U_0(z)$ , which is more precisely defined as a wind speed ratio.

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.

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”.

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

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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.

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.

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.

References Wilson, J. D., 2004: Oblique, stratified winds about a shelter fence. Part I: Measurements. *J. Appl. Meteor.*, 43, 1149-1167.

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