

Referee's Report on: "Combined wind measurements by two different lidar instruments in the Arctic middle atmosphere" by J. Hildebrand et al.

This work presents and discusses the results of two complex, highly advanced lidar equipments operating far into the Arctic circle. The results are valuable and significant and merit publication. Overall I would grade it as at least very good for Scientific Significance (2+) and Scientific Quality (2+) and as about good for Presentation Quality (2-). In places I find the expression somewhat unclear, possibly even unintentionally misleading. I have a few suggestions for clarification which, while not mandatory, I hope the authors will consider seriously, together with a few other questions and comments, as follows:

p. 4124, Abstract: the second and third sentences are very clumsy and could be more simply written, for example as "The upper altitude range of the RMR lidar, and the lower range of the sodium lidar overlap in the altitude region of approximately 78-85 km. For this overlap region we are thus able to present the first simultaneous wind measurements derived from two different lidar instruments."

p. 4129, first sentence: the internal integration of 1000 pulses is presumably 33s, at 30 Hz rate, not the 33 ms in the bracket?

p. 4132, third paragraph – line 27: the windspeed profile differences from Figure 6a are of opposite signs - minus and plus respectively. Should they not be written in the text as -20ms^{-1} and $+25\text{ms}^{-1}$. Also for Figure 6, the change of horizontal scale from (a) to (c) is somewhat disconcerting – a common scale would be better.

Otherwise I thought the analysis of Section 4.2 was most interesting and very convincing.

p. 4136, section 4.4, final paragraph: the second section contains a very interesting comment about possible explanations for the size of the derived scale height. Does this not merit at least an initial further discussion?

p. 4136, section 4.5, first paragraph, also the caption to Figure 9 states that "Lidar winds...match very well". This is probably just about true for 79-82 km, but not for the top altitudes 82-83 km where admittedly the errors for the RMR lidar are greater.

p. 4136, section 4.5, second paragraph: what is the time averaging for the temporal evolution of Figure 10? Is it the 33s integration or 1hr smoothing referred to in section 3? Needs clarification. Also in Figure 10 (also Figure 12) what is the criterion for the choice of transition point between RMR and Na lidar? Does it have any particular significance?

Also in Figures 10 and 12, what is the rationale for the choice of colour codes of windspeed? The right hand half of Figure 12 with transition blue to red around 0 seems very clear and easy to interpret. However, the three other panels with green (either side of 0) and pale blue, I find rather confusing.

Otherwise the data shown, particularly Figure 12 right hand side, is very impressive.

p. 4139, section 5: the first sentence carries the clear and misleading implication that the simultaneous and common volume observations cover the altitude range of 30 to 110 km. While the simultaneous measurements are continuous throughout, the common volume is at most about 78-85 km.

p. 4140, line 6: I dislike the term “validation” in this context, which implies the comparison of a new unproven technique against some long established and accepted standard. As I understand it, the authors are in fact trying to establish the requirements for a ‘useful and meaningful comparison’ of two techniques, i.e., simultaneous, common sounding volumes, etc.

General Comment: do the terms “line of sight”, “meridional”, and “zonal” wind need definition or explanation in the context of lidar measurements? This might be useful for the less specialist, more lidar oriented reader.

In summary, I found this altogether a fine piece of work and I enjoyed working through it. Thank you.

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