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

In general I found this paper quite interesting and certainly worth publishing. The authors have shown that blending the profiles from the two instruments increases the total range encompassed by the measurements and enables the identification of wavelike structures. However, I do have some comments on presentation and uncertainties that the authors might want to consider in order to clarify some fuzzy points and to improve the readability of the manuscript. They are listed below:

Section 2.1, Line 20: Presumably the pulses from the two lasers are interlaced in order to use a single receiver. If this was noted in the text I missed it.

Page 4128, lines 1-15: The text states that D_{seeder} describes the behavior of the detection channel. However, it seems to me that D_{seeder} also provides a correction for frequency uncertainty of the transmitted pulse, i.e., when the pulse is not exactly at the same frequency as that of the seed laser. Otherwise any frequency variability in the transmit pulse would result in additional uncertainty in D, assuming the characteristics of the iodine filter are constant. Perhaps I've missed the point here, but if so the authors might want to say a word about stability of the transmitted pulse wavelngth relative to the seeder wavelength.

Figure 2: This figure seemed a bit rudimentary to me. A bit more detail in the representation of the optical paths would be useful to the reader, it seems to me.

Page 4128, lines 13-15: As noted by another reviewer, some discussion of the joint retrieval of wind and temperature would be useful, given that the two parameters are jointly retrieved.

Page 4128, line 24: The explanation of exactly how wind is measured in the Na lidar is confined to a single sentence. The references cited do not provide much additional information. Given that this paper focuses on the wind measurements the reader should be able to get this information more readily – I suggest adding one or more references that describe in more detail the how wind is extracted from the measurements at the three wavelengths.

Page 4129, line 22: In the discussion on discarding records based on top altitude, it would be good to know if the presence of clouds or system variability (or both) are primary factors in reduced altitude coverage.

Page 4130, line 8: It isn't clear why the fluorescence signal is normalized to the Rayleigh signal for measurement of winds. This doesn't seem necessary, although I can see where it would be useful to display intensity information on the same figure.

Page 4131, Section 4.1: It seems to me that the main point of this section is to indicate that the wind speed response (transfer function) is a function of the wind speed itself (i.e., the filter response is nonlinear over the frequency region in which the measurements are made, leading to asymmetry in response), as well as the temperature. This point is not made until the end of the discussion, whereas it would be much more useful to the reader if it were pointed out prior to presenting the data in Figure 4.

Page 4131, Line18: I'm not sure why the so-called "mirror" axis (line connecting the intersections of the profiles) is discussed. If the profiles didn't have a lot of variability versus height they might not intersect at all. Again, this discussion seems unnecessarily long to make a simple point.

Page 4132, line 17: Does the author mean to talk about a "systematic over or under estimation of winds *relative to* ECMWF"?

Page 4134, lines 1-10: It seems that the statement that the wind speed and temperature both show the biggest differences at the same altitude, hence the differences are caused by gravity waves is a bit too unequivocal. Although I agree that this is probably the case, one could think of system issues that produce a similar deviation from the mean in both the wind and temperature profiles within the same altitude range, especially since the retrievals are not independent.

Figure 7: This figure is very unclear. The profiles from the Na and RMR lidars are not differentiated in the region where they overlap (although the reader can deduce which is which). Also, one cannot even make out two distinct profiles for the SET within the overlap region. Additional uncertainty is added by the overlap of the NWT and SET profiles in this region.

Page 4136, line 4: How is the composite profile formed if the profiles don't intersect in the overlap region?