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Atmospheric Measurement Techniques Discussions



# *Interactive comment on* "Combined wind measurements by two different lidar instruments in the Arctic middle atmosphere" *by* J. Hildebrand et al.

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**Sect. 2.1, line 20: are the pulses of both lidars interlaced in order to use a single receiver?**

No, the pulses are not interlaced. The fields of view of both lidars are tilted against each other to avoid interference/crosstalk.

**page 4128, lines 1–15: $D_{\text{seeder}}$ provides a correction for frequency uncertainty of transmitted pulse; some words about stability of transmitted pulse wavelength relative to seeder wavelength**

A frequency offset between transmitted pulse and seeder causes an additional uncertainty in Doppler ratio $D$. This is the reason why it is required to determine such frequency offset. This is done with an additional iodine spectrometer.

We revised the manuscript on this issue and added further information and reference.

**Fig. 2: figure seems to be a bit rudimentary**

Actually this figure is intended to be a raw sketch to illustrate only the features of the detection branch which are most important for the discussed subject.

A more detailed sketch of the detection system can be found in *Baumgarten (2010)*.

**page 4128, lines 13–15: some discussion of the joint retrieval of wind and temperature would be useful**

Atmospheric temperature is derived from a relative density profile measured with the reference channel. This technique of hydrostatic integration is described e. g. by Kent and Wright (1970) and Hauchecorne and Chanin (1980).

**page 4128, line 24: more information or references about wind retrieval with the Na lidar**

A nice overview of the wind retrieval with the Na lidar is given in Kaifler (2009).

The $D_2$ line (589.16 nm) is a prominent fluorescence line of sodium. Atmospheric motion and Doppler effect cause a shift of this line. This shift is determined by measuring the scattering cross section at three frequencies: one is locked to the $D_{2a}$ line, the



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other ones are shifted by $\pm 630\,\mathrm{MHz}$: Doppler shift causes an increase of the scattering cross section at one shifted frequency and a decrease at the other one. Hence, the ratio of the measured scattering cross sections at the shifted frequencies is a measure for line-of-sight wind speed.

It is required to take different emitted laser powers at the three frequencies into account. This can be done by normalizing the fluorescence signal at each of the three frequencies to the corresponding Rayleigh signal. The frequency dependence of the Rayleigh backscatter cross section can safely be ignored due to the small frequency range.

We will include additional information in the manuscript.

**page 4129, line 22: discarding records based on top altitude: are clouds and/or system variability primary factors for reduced top altitude?**

A reduced top altitude is primary caused by (faint) tropospheric clouds.

**page 4130, line 8: why is it needed to normalize the fluorescence signal to the Rayleigh signal?**

see answer to **page 4128, line 24**

**page 4131, Sect. 4.1: better structure of the discussion**

We revised this section seriously. The wind and temperature dependence of Doppler ratio (including Fig. 5) is now discussed in Sect. 2.1. This allows us to shorten the discussion in Sect. 4.1.



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**page 4131, line 18: why is the "mirror axis" discussed?; unnecessarily long discussion to make a simple point**

Well, it is a striking feature of Fig. 4, that both profiles seem to be mirrored at a line which connects the intersections of both profiles (at least above 65 km altitude). The question arises how to explain this "mirrored" behavior and to show its restrictions.

Since this section caused a lot of questions we revised it seriously to clarify it.

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

We clarified this sentence: "However we do not observe a systematic over or under estimation of winds in used ECMWF data."

**page 4134, lines 1–10: differences in wind and temperature at same altitude: statement, that this is caused by gravity waves is a bit too unequivocal; might there be a system issue causing similar deviations in same altitude range (both retrievals are not independent)?**

We do not see any technical reason which would effect the retrieval in such a limited altitude range. Furthermore, the derived (relatively small) temperature difference of 2 K alone could not cause such a big wind speed difference of 20 $\mathrm{ms^{-1}}$.

**Fig. 7: figure is very unclear, profiles are hard to distinguish**

We added an additional figure showing a close-up between 70 and 90 km altitude (see figure below).

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

The wind speed profiles of RMR lidar and Na lidar intersect at 82 km altitude. Above we use data from the Na lidar.

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Interactive comment on Atmos. Meas. Tech. Discuss., 5, 4123, 2012.

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Interactive Comment

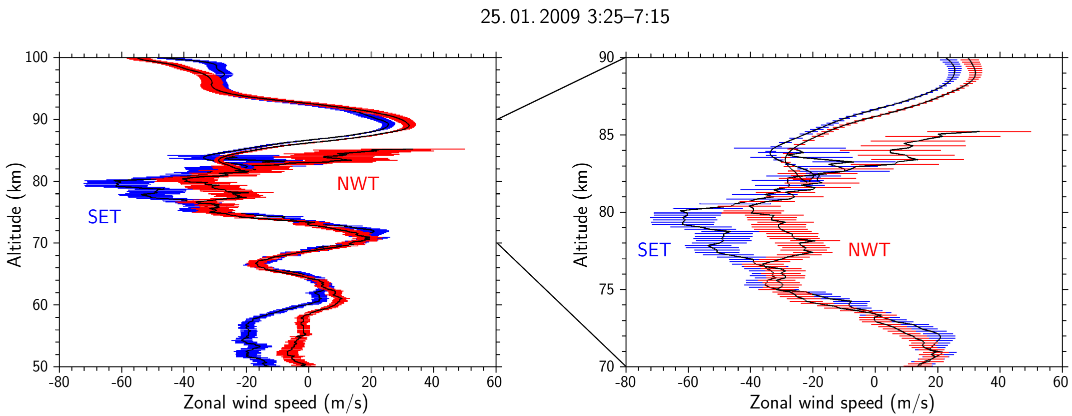


**Fig. 1.** Fig. 7 with additional close-up (between 80 and 85 km error bars are shown for each other data point only)



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