

Review of Baumgarten (2010): „Twin Doppler Rayleigh/Mie/Raman lidar for wind and temperature measurements in the middle atmosphere up to 80 km“; AMTD, 1 July 2010

General Remarks:

The paper describes the setup and first measurements of a Doppler lidar for wind measurements in the middle atmosphere using iodine filter technique. First simultaneous measurements of wind and temperature are reported for altitude up to 80 km for the first time. This is of high scientific significance.

The paper provides novel instrument developments for wind measurements in the middle atmosphere, based on techniques, which were applied in the lower atmosphere before. The paper is very clear and well written and includes very good and appropriate figures. The overall quality of the paper is high. So I suggested immediate publication in AMTD.

Nevertheless I have 2 major and several minor comments and editorial suggestions to the paper, which should be addressed in a revised version.

Major comments:

- 1.) My main point is that I am missing a clear description of the wind retrieval algorithm in a separate section or at least a specific paragraph within section 3. The information for the wind retrieval is spread among several places within section 3 (minor comment no. 11 and 14) and section 4 (background subtraction and a 2-km running mean filter).
- 2.) My second major comment is related to the wind retrieval accuracy. The statistical uncertainty is stated in the abstract (line 5) and the conclusion (line L8), although the manuscript does not provide any details, how these numbers were obtained and derived. Chapter 4 contain numbers of 9 m/s and 19 m/s, and it is also not clear, how these numbers were derived – from the signal intensity fluctuations? So either a paragraph about the wind retrieval accuracy should be added, or the sentence about the statistical uncertainty should be deleted in the abstract and conclusion.

Minor comments:

- 3.) Title: It is not clear what “twin” refers to – wind and temperature? It is also not described in the text. Thus I suggest removing “twin” from the title.
- 4.) P2780, L25: The given references are not suitable for winds above 15 km , e.g. Liu et al. 1997, does not report about wind measurements above 15 km; others are missing e.g. Garnier and Chanin1992, or Gentry et al. 2000. As the paper reports about direct-detection Doppler lidar using iodine filter technique, the related work for tropospheric winds with this technique should be mentioned within 1-2 sentences and proper references should be given, e.g. Liu’s papers 1997, 2002, and 2007.

- 5.) P2781, L15: The sentence “Up to now .. “ is misleading, because Huang et al. reported about temperature and wind lidar measurements up to an altitude of 50 km already (but not above). So it should be reformulated to make this clear.
- 6.) Figure 2: It is not motivated in the text, why the absorption line S57 is shown in Fig. 2. I understood from the text that L38 is used. Also the text (P2783, L14) is not clear. What is the temperature of the cell with some remaining I2 in the bulk phase? Does it refer to the S57?
- 7.) Fig. 2 and text: It should be stated in the text, where the relative position of the transmitted laser pulse frequency wrt the I2 absorption line is placed for wind measurements (steepest slope?)
- 8.) Laser pulse length and FWHM at 532 nm should be added in the text
- 9.) P2783, L17: It should be added in the text, that the 4 pm filter is realised by a double etalon at 532 nm. Some descriptions of the etalon should be given, e.g. plate distance, FSR, Finesse. What is meant by “double”? Is it 2 etalons in serial implementation? Also it is not mentioned, how the 130 pm bandwidth is realised during nighttime.
- 10.) Fig 3 contains a “high finesse wavelength meter”. This is not described in the text. Some details (commercial?), accuracy, and purpose in the setup should be given in the text.
- 11.) P2784, L11: How is the temperature influence handled in the retrieval algorithms? Is it a correction on the retrieved winds or is the Dmodel calculated for the actual temperature profile and then the wind derived from this Dmodel(Tactual)? The retrieval method should be described in 2-3 sentences.
- 12.) P2784, L27: Is the normalisation performed at 1 specific altitude? Is this indicated by the grey arrows in Fig. 6 left?
- 13.) P2785, L13ff: Do the parameters wavelength offset and D_0 used in the wind retrieval. How is the parameter D_{NWT} and D_{SET} used in the wind retrieval? It is not clear, because this parameter should affect both the channels before and after the I2 cell? Is this parameter range-dependent (due to its sensitivity to alignment), and are there different parameters for the L/M/H channels?
- 14.) Fig. 7 and text: What is causing the high backscatter ratio below 34 km on January 17: It is written in the text, that the station was outside the polar vortex on January 17 – so the signal is not coming from PSC?
- 15.) Fig. 8: Scale of vertical wind should be rather ± 20 m/s rather than ± 100 m/s; the different colors and styles (solid, dotted) of the lines used in Fig. 8 should be described in the caption.
- 16.) P2787, L25: How were the numbers for the statistical uncertainty of 9 m/s and 19 m/s derived?
- 17.) Fig. 10: To my opinion this Fig. 10 with the ECMWF model fields is “nice-to-have”, but not relevant for the main portion of the paper, which describes a new instrument and first analysis. Also the content of Fig is not discussed in detail in the manuscript and the main information from the ECMWF analysis is already included as profiles within Fig. 8 and 9. Thus the author could think about removing Fig. 10.
- 18.) P2789, L9: an uncertainty of 20 m/s is reported at 80 km, while a number of 10 m/s is provided in the abstract.

Editorial comments:

- 1.) P2780, L2: delete “shift” or write “Doppler frequency shift”; also “system” could be replaced by “lidar”
- 2.) P2780, L3: more common to use “random error” or “precision” (or “accuracy”) rather than statistical uncertainty
- 3.) P2780, L9: “multi-wavelength” instead of “mulit-color”; also wavelengths should be given explicitly.
- 4.) Fig. 1: R/M/R acronym not explained in caption or text.
- 5.) P2781, L8: The sentence “Radar observations ...” contains 2 times the MST radar. For the second time no height interval is given. Is it the altitude range of 80-90 km? Sentence should be rewritten.
- 6.) P2782, L3: “is about 4 MHz for a wavelength of 532 nm ..”; wavelength should be stated here, because it was not introduced before.
- 7.) P2780, L5: Is “only” referring to “only a signal ratio of” or “only a precision of”. This is unclear. The word “only can be deleted.
- 8.) P2780, L7: delete “only”. I suggest inserting “In order to measure the horizontal wind vector, we use two ..”
- 9.) Fig 3: BWT acronym not explained.
- 10.) Fig. 5 a) it should be mentioned in the caption that the 0.4/0.6 black lines are isolines
- 11.) Fig. 6: grey arrows in left figure should be explained; right: only a red and a black line is shown, but no red and blue horizontal bars.
- 12.) P2785, L9: Is there a reference, where the retrieval and the accuracy of the backscatter ratio for this system is described? If yes, this reference should be added.
- 13.) P2788, L6 and L26: “..” dots should be replaced
- 14.) References, Friedmann: “Doppler lidar”