General comments

The paper describes the methodology and results of a field campaign aimed at comparing the performances of different types of Doppler lidar for range-resolved wind-velocity measurements, as a part of the concept validation of a space-borne lidar able to measure wind at global scale and at altitudes above ground with low aerosol content. A VHF wind profiler radar and the launching of radiosondes provided reference measurements.

Although the campaign was carried out in July 1999 and a UV lidar based on the double-edge technique concept tested in the campaign is to be soon flown on the ESA's ADM-Aeolus mission, the methodological aspects are still valid, especially in the prospect of calibration-validation activities for that mission. Although this fact is mentioned by the authors (e.g. p. 4554, lines 13-15; p. 4563, lines 1-3) it should be further stressed and probably included in the abstract.

The title highlights the $0.355\ \mu m$ lidar, but in the body of the paper this lidar seems to be on an equal footing with the other lidar instruments. The authors should stress the special role this lidar played in the campaign – was the campaign decisive for the selection of a UV double-edge direct detection lidar for ADM-Aeolus? Was the decision already made and the campaign intended only to confirm the soundness of the technological choice? Moreover, in the reviewer's understanding the selection of a UV lidar for ADM-Aeolus is based on its capability for measuring wind velocities in free-atmosphere regions where molecular scattering is much stronger than aerosol scattering, which involves scattering greatly enhanced as the wavelength is decreased, as well as a wide spectrum of the scattered radiation because of the wide spectrum of velocities of the molecules around their mean (wind) component. This seems not to be stressed enough; in fact the sentence that addresses this, starting on line 25 of page 4553, – "For atmospheric molecules are uniformly distributed geographically with a known dependence in height, ESA decided to select in 1999 a spaceborne wind lidar based on molecular scattering at 0.355 μm" – is probably too weak and a little confusing, as there is probably not other way for measuring the wind velocity in the upper atmosphere through backscatter lidar techniques than relying on molecular backscatter.

Although there is no problem most of the times in understanding the English writing, it should be revised and polished. A too hurried writing is detected in many instances.

Specific comments

1. Because a UV Doppler lidar should perform better in the absence of aerosol than lidars at longer wavelengths (at least for similar energy of the transmitted pulses and collecting-aperture size), one would expect a priori that field campaign results reveal better performance above the boundary layer for this lidar than for the other ones, or at least an improvement in its comparison with the $0.532\ \mu m$ one. However an analysis of the performance as a function of the height is not found in the paper. Tables 4 and 5, which summarize the performances taking as reference the radiosonde-derived velocity, do not state the range of altitude values for which Eqs. (2) and (3) have been computed. The range must be stated in the table caption as well as in the text, where it doesn't seem to be specified either. It is also strongly suggested that results are given for

different range intervals, to show possible changes in the performance as a function of height. Likewise, more detail should be given about the 0.532 μm lidar direct-detection Doppler lidar to place in full context the comparison with the 0.355 μm one. In fact, there is a lack of homogeneity in the way the different lidars are described, much more detailed technical information being given in the text for the 10.6 μm heterodyne one than for the 0.532 μm one; even if specific references are given for the latter, more technical details should be explicitly included in the paper. In turn, the characteristics of the 0.355 μm lidar are given in table form (Table 1).

In general, a critical assessment of the campaign results is missed, as well as the reasons for the selection of those that are highlighted: how well are the objectives stated on lines 24-27 of page 4554 (to compare the performances of the different lidar techniques in various meteorological conditions, to demonstrate that the retrieved wind velocities are the same (within the statistical error) and to explain the differences in complex situations) fulfilled? Some more discussion about this would be helpful for the reader. What's the reason for selecting the 12 datasets of table 3? Their representativeness of different atmospheric conditions? Are the results from other possible datasets in agreement with those of one of those selected corresponding to similar atmospheric conditions? What's the reason for choosing to highlight the results of 20, 21, and 22 July rather than those of other selected days? In connection with Fig. 4, would the other lidars in the campaign, in particular the 0.532 μm one, show similar deviations beyond the instrument accuracy limits? Concerning these limits, Table 5 gives two values for the instrumental error for DC-DDL and DEDG: what do those two values correspond to? There seems also to be some internal inconsistence in the ascription of the cause for those deviations: on page 4561, lines 17-20, the reason seems to be attributed to a change in the aerosol properties, whereas on page 4562, lines 19-20, the explanation seems to be the difference between the volumes sensed by the lidar and the ones where the radiosonde has been drawn by the wind.

2. The explanations on lines 15-20 of page 4553 about heterodyne detection and direct detection suffer from a too hasty writing. The sentence "Heterodyne detection technique analyzes the backscattered spectrum from aerosol or cloud particles" is imprecise. It would be more exact to say that this technique is better suited for measuring the Doppler shift of the radiation (or the spectrum) scattered by aerosols or cloud droplets, because this spectrum is narrow and doesn't pose too demanding requirements on the intermediate frequency stages of the receiver electronics (that should let pass signals with bandwidths on the order of GHz if the radiation scattered by molecules was to be used). A more detailed (without being exhaustive) description of the direct-detection double-edge technique would also be desirable here, to put forward its advantages with respect to the heterodyne one when it comes to rely on molecular backscatter. This should also help understand entries on Table 1 such as "Number of etalon channels", "Laser etalon separation-locking ch." and "Laser etalon separation atm. Ch." For the overall structure of the explanations it would probably be better to start with a brief description of the spectra backscattered by particulates and by molecules, then explaining the suitability of the different techniques to measure the Doppler shift in situations dominated by either aerosol or molecular backscatter.

3. Does the reference list given on lines 2-5 of page 4554 intend to be representative in general? If yes, probably references on CO_2-laser-based lidars developed at NOAA

should be included. If not, the context in which the references must be considered should be discussed.

4. In addition to produce tables like tables 4 and 5 for different height intervals, it would also be interesting to have tables comparing the different instruments against each other. For example, letting aside the question of the different height intervals, table 4 could be split into three tables, each one giving the correlation coefficient for the corresponding measured velocities between pairs of instruments. Such tables could look as

Table x. Average cross-correlation coefficient of the absolute value of the measured velocity

	0.532 µm DC-DDL	0.355 µm DEDG	10.6 µm HDL-LMD	Radar ST	Radiosonde
0.532 µm DC-DDL					
0.355 µm DEDG					
10.6 µm HDL-LMD					
Radar ST					
Radiosonde					

Of course, the values of the principal diagonal of the table would be 1. In this way, a picture of how each instrument behaves as compared to each other would be obtained, and possible effects related to the radiosonde drifting would be revealed (one would expect better match between measurements on very similar volumes).

5. Figures 3, 4, and 5 are very small. This can be a typesetting issue, as they don't get blurred when the view is blown up. However the quality of fig. 2 seems definitely too poor.

Technical comments

1. Page 4552, lines 3-5: "A space based Wind Doppler lidar mission so-called ADM-Aeolus is currently developed by the European Space Agency for a launch in 2015"
Comment: This is an example of sentence requiring a more formal English writing. "The ADM-Aeolus space-based wind Doppler lidar mission is currently developed by the European Space Agency for a launch in 2015" is suggested.

2. Page 4552, lines 16-18: "The world wide radio-sounding network is the backbone of the World Meteorological Organization with aircraft, buoys and meteorological radars".
Comment: The sentence writing is confusing: is it meant that aircrafts, buoys and meteorological radars are also part of the WMO's backbone, or that the backbone is the radiosounding network alone?

3. Page 4552, line 22: "the wind data set such as".

Comment: the following writing is suggested: “the wind data set provided by”,

4. Page 4553, lines 1-2: “implementing a single mode doubled Nd-YAG laser and direct detection”
Comment: the following writing is suggested: “implemented with a single mode frequency-doubled Nd-YAG laser and direct detection”.

5. Page 4553, lines 2-3: “Then the technique implemented a tripled Nd-YAG laser emitting at 0.355 μm”
Comment: the following writing is suggested: “Then the technique was implemented with a frequency-tripled Nd-YAG laser emitting at 0.355 μm”.

6. Page 4553, lines 19-20: “(it results in so called 20 Rayleigh–Brillouin spectrum)”
Comment: One or several references are needed here.

7. Page 4553, lines 28-29: “and fulfills eye safety regulation”
Comment: does this matter for a space-borne lidar?

8. Page 4554, line 5: “for the 10 μm heterodyne detection technique”
Comment: the heterodyne lidar used in the field campaign described in the paper is sometimes referred to as the “10.6 μm” lidar, and sometimes as the “10 μm” lidar. The terminology should be unified for the sake of internal consistence.

9. Page 4554, lines 17-19: “and then the inter comparison with two other wind lidars: 0.532 μm direct detection and 10.6 μm heterodyne detection, and 72-MHz radar”
Comment: revise the sentence to make it clearer.

10. Page 4554, line 23: “operated by Service d’Aéronomie”
Comment: complete the affiliation.

11. Page 4554, lines 24-25: “One objective is to compare the performances of the different lidar techniques in various meteorological conditions, to demonstrate that the retrieved wind velocities are the same (within the statistical error) and to explain the differences in complex situations.”
Comment: which are the other objectives? Or should the sentence read “The objectives are…”?

12. Page 4555, lines 3-4: “The Fabry Perot etalons bandwidths or so-called edges are symmetrically located”
Comment: The English writing is awkward, and the sentence confusing. It seems to imply a terminological equivalence between “bandwidth” and “edge”. “Edge” rather refers to the edges of the pass bands of the etalons, which have some bandwidth.

13. Page 4555, lines 20-21: “where $R(r)$ and $R_{vert}(r)$ represent the ratio of the intensities in the two Fabry–Perot etalons”.
Comment: It would be more precise to say “where $R(r)$ and $R_{vert}(r)$ represent the ratio of the intensities at the outputs of the two Fabry–Perot etalons”.

14. Page 4557, line 9: “VHF 72-MHz stratospheric-trospospheric radar”

Comment: Because the term ST-radar is used afterwards, with ST standing for stratospheric-tropospheric, the definition of ST should be included, i.e: “VHF 72-MHz stratospheric-trospospheric (ST) radar”. Also, basic information on the radar specifications should be included, and possibly a reference for more complete information.

15. Page 4557, lines 14-15: “It can be noticed that the vertical resolution varies as a function pulse length and line-of-sight”
Comment: information on pulse length and line of sight should be included on Table 2 for its influence on the vertical resolution to be noticed. No information about pulse length seems to be given in the paper. Information about the line of sight is only found in the next page. Note also that the sentence should read “as a function *of* pulse length and line of sight”.

16. Page 4557, line 19: “representativeness errors”.
Comment: what’s a representativeness error? Maybe the authors mean “representative errors”?

17. Page 4559, lines 11-12: “if it is 0 the fluctuations are randomly distributed around their own average value”.
Comment: the “if” seems to be misplaced. The sentence should read: “it is 0 if the fluctuations are randomly and independently distributed around their own average value”. It could be thought of situations where the correlation coefficient is 0 without the fluctuations being randomly distributed around their average value. However, if the fluctuations are randomly and independently – with respect to each other – distributed around their average value, the correlation coefficient will always be 0.

18. Page 4559, line 16: “The Root Mean Square Error is the average absolute value of the difference of wind velocity estimates between two profiles”
Comment: the definition given in this sentence does not match the description given afterwards and Eq. (3). It is suggested to drop this sentence and starting section 4.2 with the next one.

19. Page 4560, line 8: check the call to Table 3. It should probably be to Table 2, where the instruments are listed.

20. Page 4560, line 10: “can drifted” should be “can drift”.

21. Page 4560, lines 14-19: “The wind fluctuations due to orography are then more likely meridional than zonal especially in strong wind conditions (Mistral) as shown in Fig. 3. The effects are expected to be stronger in the lower atmosphere (0–5 km). The instrument spatial resolution is an important variable, especially in the lower troposphere, where atmospheric layers are thin. For these reasons, the remote sensors sometimes do not follow the wind fluctuations.”
Comment: the explanations given in this sequence of sentences should be stated in a more precise way. What is the spatial resolution an important variable for? The sentence seems to imply that instruments with better spatial resolution should score better in the figures of tables 4 and 5 – by the way, is the last column (corresponding to the radar) of table 4 right?: the numbers are exactly the same as those in the column to its left. However, letting aside the radar, which is not looking along the same direction as the

lidars, the system that seems to perform better (higher correlation coefficient, lower difference with respect to radiosonde) is the 10.6 μm heterodyne lidar, which is not the one with better spatial or temporal resolution.

22. Page 4561, lines 1-2: "The results show that the 10.6 μm HDL-LDM is more precise, at lower altitudes"
Comment: altitudes are not explicitly mentioned on Table 5. Maybe the two values of instrumental error given for the direct-detection lidars correspond to two different ranges of altitudes, but these should be explicitly stated. For the heterodyne lidar only one value is given; again, the range of altitudes for which this instrumental error applies should be given.

23. Page 4561, line 8: the acronym RS should be defined the first time it is used.

24. Pages 4561-4562, section 5.3: why does this section (Discrepancies observed) seem to be exclusively centered on 22 July 1999?

25. Page 4561, lines 23-24: "Strong winds were inducing gravity waves at low altitudes with significant vertical velocity"
Comment: was this confirmed by the radar, which was able to retrieve the vertical component of the velocity?

26. Page 4561, lines 26-27 - page 4562, lines 1-2: "A very large discrepancy between the remote sensors and RS is present around 10 km (a difference of about 22ms−1). This is due to the fact that the communication with RS was lost between 8 and 10 km. On this day, the RS wind profile is reliable."
Comment: If the communication with the radiosonde was lost between 8 and 10 km, where do the velocities between those altitudes come from? Are they dummy data generated inside the receiver? Wouldn't be better in that case not to present radiosonde data in that range? If data in that range were used for the statistics on tables 4 and 5, are not they contributing to obtaining worse values than they should? Is the last sentence ("On this day, the RS wind profile is reliable") right? Shouldn't it be rather the opposite "(On this day, the RS wind profile is *not* reliable")? In that case, wouldn't it be better to use another day for the examples?

27. Table 1: the last 3 entries of the table are difficult to understand without a more detailed description of the system architecture.

28. Tables 2 and 4: the name conventions for the different instruments are not the same in either table. Those on table 2 do not correspond either to those used in the text. For instance, for the 0.532 μm direct-detection lidar, the designation convention "532 nm DD-Lidar OHP" is used on table 2, whereas "0.532 μm DC-DDL" is used on table 4 and in the text. The other instruments suffer of the same lack of homogeneity in their designations. It would also be helpful to give a reason for the abbreviations used (e.g. what does DC-DDL stands for?).

29. Table 4: the caption should be more precise, for example: "Average cross-correlation coefficients between the wind velocities retrieved by the different instruments and those provided by the radiosonde on selected cases". A similar remark applies to the caption of Table 5.

30. Fig.2: the figure quality is poor. Concerning the caption, “Example of balloon trajectory…”, instead of just “Balloon trajectory…” is suggested. The last sentence (“The valley effect is clearly visible”) should be made more explicit: what is the reader supposed to notice?