Comments of the authors to review of the anonymous referee 1 (C1166)

The authors thank the reviewer for his comments to improve the paper. Below we respond (italic) to the author comments (standard).

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The authors refer to the single line-of-sight ADM wind observations as wind profiles. This is misleading to many readers who expect a "wind profile" to provide speed and direction as a function height. This is not the case for ADM.

It is mentioned in the introduction that "The instrument thus measures a profile of single wind components along the laser beam line-of-sight (LOS) rather than the full wind vector." An additional nuancing will be added in the abstract.

Specific Comments

While the paper is based upon the level- 1 CALIPSO products, an explanation of how the level 2 CALIPSO data products may impact any conclusions published in this paper should be provided.

The main limitation of the CALIPSO level-2 product is the coarse resolution, in particular for the aerosol product, that limits to "simulate small-scale atmospheric processes (heterogeneity) within the Aeolus measurement volume." as mentioned in the Introduction. The CALIPSO level-2 dataset is very well suited to validate our results. In particular the level-2 aerosol classification product could provide improved values for the lidar ratio that is a crucial parameter for the retrieval of aerosol backscatter as mentioned in the last paragraph of section 2.1.4 and section 5.

Section 2.1: The statement " the discrimination between atmospheric scenes with clouds, aerosol or combinations of both….less relevance for simulating Aeolus winds" is confusing since the heterogeneous scenes are a challenge to accurate wind observations with ADM.

This sentence is indeed misleading. The point is that for filling the database the optical properties of the atmospheric particles are of interest only, not the exact characterization clouds and aerosols. The sentence is replaced by: "A further characterization of cloud and aerosol types, their particle size distribution, etc, is of less relevance for simulating Aeolus winds."

Section 2.1.2: The last sentence in section 2.1.2 needs to expand on what a magnitude estimate would be for "too small/large lidar ratio". This sound like a serious weakness, but may not be the case.

The last sentence is mainly a summary of the discussion in section 2.1.2. The sketched procedure yields an estimate of the aerosol lidar ratio, starting from the default value of 35 sr. The estimate will generally differ from the inherently unknown true value of the aerosol layer. The last sentence then explains the consequence on the retrieved magnitude of the aerosol backscatter when using a smaller/larger value than the true value.

We changed the sentence "In summary … aerosol backscatter" to "In general, the magnitude of the retrieved aerosol backscatter is sensitive to the lidar ratio value used in the retrieval algorithm. A smaller/larger value than the inherently unknown true value of the aerosol layer results in an under/over-estimate of the retrieved aerosol backscatter that may be in the order of 100% for large discrepancies. The validation in section 2.1.4 will show that such large discrepancies are rare.

Section 2.1.3: Exceptions to the use of an invariant lidar ratio between 355 and 532 can be quite large and thus should not be dismissed without some discussion and estimate of the range of lidar ratios for differing aerosol models..can use Omar's if desired (referred to in section 2.1.2)

We agree. As mentioned in section 2.1.3 below eq. (11), S532/S355 may vary between 0.5 and 1.7. Omar found typical values in the range of 0.44 (clean marine) – 2.33 (polluted continental) for S532/S1064. Omar does not provide values for 355 nm.

The following sentence is added to the text after (Flamant et al., 2008-II). "Omar et al. (2009) show typical variations from unity of -56% (clean marine) to 133% (polluted continental) at 532 nm and 1064 nm wavelength.

Section 2.1.4: The assumption of a constant lidar ratio, while not totally without merit, is off-putting and results in unrealistic distributions as shown in Figure 5.

The constant value of 35 sr for background aerosol is representative for most of the troposphere but indeed less realistic for aerosol layers in the lower troposphere. The algorithm corrects the lidar ratio in case of solution divergence as explained in section 2.1.3.

Section 2.1.4: While Aeolus may be able to penetrate thin tropical cirrus, the losses will reduce the accuracy of the wind products below the cloud layers. In many (>50%) of the situations with tropical cirrus, one might expect a velocity error increase ~ 40 -50%. If this is the case, "good quality winds" should be further annotated.

That is right. From Table 11 (apologize for the incorrect numbering) and section 2.1.4 it follows that "Tropical cirrus cloud is optically thin in general with a two-way transmission of more than 0.6 at 355 nm in 75% of the cases." A 40% signal loss yields an increase of the wind error standard deviation by a factor of 1/sqrt(0.6)=1.3 below the cloud. Corresponding (Rayleigh channel) wind errors are still within the mission requirement and thus annotated as good.

This remark will be added to the text.

Section 3: Shear with varying aerosol /cloud densities is certain to be a challenge to a wind measurement made over 1 -2 km layers. Is there a way for Aeolus to process the data over thinner layers at the expense of accuracy per layer?

This is one of the key questions we aimed to answer in a separate study on vertical sampling strategies for Aeolus. One possibility is to increase the Mie channel resolution (to 250 or 500 m) in regions where we expect varying aerosol/cloud densities and shear, e.g. near tropopause height, (tropical) cirrus, top of boundary layer.

Technical Comments
Figures 1,2,6,7, & 8 are much too small to read (even with glasses).
Section 1. Correct grammar " Radiosonde data do also not provide…."
Section 2.1.1 Correct grammar " …lidar beam is not capable to penetrate…"

These technical comments are implemented in the updated version of the paper.