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Discussions

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Interactive comment on "Validation of ash optical depth and layer height retrieved from passive satellite sensors using EARLINET and airborne lidar data: The case of the Eyjafjallajökull eruption" *by* D. Balis et al.

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Response to reviewer #2

We would like to thank the reviewer for his/her fruitful comments that helped to improve our manuscript.

"Correlation coefficient is not enough to define the correlation between satellite retrievals and ground based/airborne based measurements. Correlation coefficient is related with the linear regression between the two sets of data which does not follow 1:1 line. A high correlation coefficient alone does not mean that it exists a good fit be-

tween the data. An analysis of the residuals is required as well. Please consider a more complete analysis. Draw regression line along 1:1 line and discuss bias, residuals etc."

The reviewer is right. Additional results from the statistical analysis (mean bias, rms difference, the slope of the regression line) are shown in the tables and discussed. The figures have been modified accordingly in the revised manuscript.

"pp 5 l 17: define TOVS "

TOVS stands for TIROS Operational Vertical Sounder and has been introduced in the text.

"pp 7 l 7: please describe how LR was chosen and its implication on aerosol extinction coefficient"

An extinction-to-backscatter ratio (lidar ratio) of 60sr was used for the inversion of lidar signals; this lidar ratio was determined in such a way as to satisfy the constraints of a molecular signal below and above lofted layers. This has now been specified in the text in section 2.2.2. Please see Marenco et al, 2011 for details.

"pp 7 l 23: what do you mean by "the closest point in space and time"? Please provide numbers."

We consider for each coincidence the closest point in time and space within the colocation criteria shown in Tables II to VII. The colocation criteria define the upper limits, so the true coincidences in time and space are variable but within these limits. This has been explained in more detail in the text.

"pp 7 l 25: when talking about spatial and temporal filtering, do you refer to the lidar data? Also, please describe the technical details of the filtering (e.g. moving average, resolutions etc)"

What we mean here is that first the spatial colocation criteria have been applied to the satellite data and then the temporal ones. The sentence has been corrected accord-

ingly.

"pp 9 l 28-30: talking about cloud contamination in GOME-2A: isn't possible to screen the cloudy events?"

What we mean here is that despite the screening of the cloudy events contamination could still be possible from thin clouds in the satellite retrievals considering the pixel size compared to the point lidar measurement. The text has been modified accordingly.

"pp 10 l 21: why the number of coincidences decreases? "

The ULB and UOXF algorithms have different criteria for considering a retrieval as successful.

"pp 10 l 22-23: what is the physical meaning of the "ensemble average"(over the total number of coincidences) of AOD (table IV)? I mean relative error would have been useful."

The tables have been modified to include additional statistics as mentioned already in our response to the 1st comment of the reviewer.

"pp 10 l 26: why do you mention the height of 800 hPa while Fig. 2 is based on the height of 600 hPa? "

Table IV shows results also from comparisons of the "fast algorithm" not shown in Figure 2 in order to reduce the number of subfigures. In figure 2 we only show the 600hPa because it shows the best overall agreement relative to the 800hPa and 400hPa estimates. A relevant comment has been added in the revised text.

"pp 11 l 8-9: the same question for the mean of ash plume height?"

The fast algorithm does not provide plume height, it assumes a fixed plume height.

"pp 12 l 2: what do you mean by "the closest point in space"? Between 50 km and 200 km as mentioned earlier?"

Yes, see our response to a previous comment on the colocation criteria.

"pp 13 l 26: what do you mean by "very good agreement"? Please provide r2. Why didn't you provide a scatter plot as in the case of EARLINET comparisons?"

The airborne lidar data give a time series of data for each measurement day. As data are not truly coincident (the overpass time being early in the morning and late in the evening whereas flights were near the middle of the day), volcanic plumes have undergone advection between the measurements. Looking at the data as a time series makes it easier to capture differences due to the misplacement of plumes. We do not show correlation coefficients and scatter plots for the aircraft-satellite comparisons because these are not truly coincident and thus the estimated statistics do not show a good correlation. This could be misleading concerning the usefulness of the comparisons and therefore we decided to show and discuss only qualitatively about the spatial consistency between the aircraft and the satellite data.

"pp 13 l 32: Please rephrase "present the validation". As seen by these results, in my opinion, the validation is not satisfactory (based on present results). It is kind of an attempt to validate... How would you define the criteria for validation?"

We modified the text as follows "present a first attempt to validate improved . . .". There were no predefined validation criteria, and no specifically designed validation campaign. Actually in this paper we examine the consistency between the lidar and the satellite data for volcanic ash retrievals. A relevant comment has been added.

"pp 23 l2-5: please reformulate. There is no middle panel in Fig 1."

The figure caption has been corrected accordingly.

"pp 30 Fig. 2: middle plots: why there are 18 cases on the left plot and 20 cases on the right plot? Then the bottom plot has 13 cases? Please explain. I am also surprised by large r for the middle and lower plots. The data may be correlated but not with respect to 1:1 line. Please comment on this. The last plot in Fig. 2 looks to me very similar with

the lower plot on Fig. 3 while they have quite different r. I know we talk about different quantities in the two figures but the points are spread quite similar."

The different number of cases depends on the number of successful satellite retrievals within the spatiotemporal criteria applied and is different for each algorithm. A relevant comment has been included in the text. The discussion on the correlation has been improved and the additional statistics have been included in the discussion.

"pp 32 and pp 33: scatter plots as for EARLINET, including statistics (r, N) will help comparing the results and be consistent in validation criteria"

See our response to a previous comment on aircraft-satellite comparisons.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2015-1041, 2016.