Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2018-375-RC2, 2019

Atmospheric Measurement Techniques Discussions

Interactive comment on "The Mainz Profile Algorithm (MAPA)" *by* Steffen Beirle et al.

Anonymous Referee #1

Received and published: 2 January 2019

General comments

Beirle et al. introduce the Mainz Profile Algorithm (MAPA) on the example of measurements taken during the CINDI-2 campaign. The algorithm is based on parametrization and depends on a pre-calculated LUT. The algorithm itself, its a priori assumptions, a flagging scheme, as well as the still discussed and unsolved issue of an O4 scaling factor (SF) are thoroughly discussed. The manuscript is well structured and the results show good agreement with independent measurements. However, the authors should clarify three major issues:

1. A new version of MAPA is presented but the description of differences to older versions is split up across the complete manuscript (e.g. in Sec. 1, 2.3, 2.5). Please provide one single section with differences to the older versions and

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relevant improvements. Furthermore, a brief outlook of features (also new nodes for the LUT) which will be implemented in the near feature should be given. It is interesting for users to know which aerosol settings will be available soon (which SSA and asymmetry factors).

2. Figure 6 depicts results for a variable scaling factor. Unfortunately, the corresponding SF are not shown. Since these variable SF are also discussed in Section 4.4, it would be interesting to show the variability of the SF and the dependence on different flags and profiles.

3. The flagging discussion in Section 4 is questionable as specific flags are changed while keeping the other flags at their default values. As the discussion of flagging is valuable because it hasn't been covered thoroughly in other publications, this analysis should be repeated by applying and changing one flag at a time. How else could you know, if the change in one flag does not mainly affect profiles which were already flagged by other thresholds? Furthermore, it would be interesting to see the actual (AERONET) values of asymmetry factor and SSA, together with the information of the flagging scheme, to identify inaccuracies based on a wrong aerosol assumption.

Specific comments

Table A1: Why are the RAA values chosen that coarse for RAA $\geq 30°$? I would expect that results might change a lot for backward scattering, depending on the aerosol phase function, when changing the RAA results from e.g. 180 to 165.
P4, L7: You wrote that p and T profiles are extrapolated when surface values are provided. How is this extrapolation done? How large would you estimate the uncertainties when doing this extrapolation?

P8, L6: I would add that the agreement might be similar but it is also allowed to be slightly worse based on the definition of $R/R_{bm} < F$.
P8, L9: Please add here that the weighting with $1/R^2$ is referred to as weighted mean because the question about the weighting might arise in Line 19.
P8, L25, Fig 2,3: Thank you for changing the line width during the quick access review. However, now the min and max curves are missing.
I was wondering about these min/max curves in the first version of these figures. The curves represent aerosol scenarios with different AOTs (roughly estimated as 0.74, 1.47 on 15/09). How is it possible that these different AOTs do not lead to larger deviations in the O4 dSCD depicted in the corresponding sub-figures? Same for NO2?
Fig 2,3: I would suggest to change the x-axis of the EA/dSCD plots to a numbering of EA instead of the actual values. I this way, the more important details for lower EA are easier to identify when using an equidistant spacing.
Tab 4: Since Θ_R scales with S_{err}, please add information about this in Table 4.
Fig 4-8:

1. Please show all profiles in this kind of plots and use e.g. red rectangles around the flagged profiles to further indicate the discarded scenarios.

2. It would help if you could add regression lines (and corresponding parameters) and Pearson's correlation coefficient to the figures, for valid and valid+flagged profiles respectively.

3. Please add error bars to the sub-figures d-f.

4. Additional markers for the cloud classification scheme from Section 4.5 should be added to indicate the cloudiness during the corresponding measurement.

Fig 4: I am wondering why MAPA finds nearly all profiles as having issues with the

height flag, on 15/09. When considering that the aerosol load was mainly concentrated close to the surface (Fig 5), this indicates an issue with the algorithm or the flagging scheme/threshold. I would not expect a deviation in the profile shape when no SF is applied. And why is one warning enough to discard the corresponding profile? This appears to be a bit too strict.

P13, L29: Please add a time series of this variable scaling factor and a brief discussion.

Fig 6,7: Do you have an explanation why your results and LP DOAS data differ mostly in the morning hours (and the late afternoon)? Is this also a problem for the other days of the investigated time period?

P16, L6: If a lower F leads to more profiles and the correlation is not deteriorating much, I am wondering why the default is 1.1? Furthermore, when F = 1.3 leads to less profiles due to consistency issues, isn't it possible that the consistency threshold is the problem?

P16, L27-28: An increase of the threshold R_n leads to more profiles without a deterioration in r. Could you please test if this is still true for an even larger increase?

P17, L12: "Here we focus of..." → "Here we focus on..."

P17, L14, L29: Here I do not see the point in using 3km v0.96 led to r = 0.826 and $\Theta_h = 4$ led to r = 0.783 with 337 and 338 profiles, respectively. One single profile was responsible for this drastic decrease? I would rather say that the individual scenarios at the prevalent site and time led to the conclusion of using 3km instead of 4. This might be completely different for other measurement locations, even though the sensitivity is highest for the lowest altitudes.

P18, L6: If the variable SF leads to a similar agreement but more profiles remain, why isn't that the preferred option?

P20, L24: What would be the retrieval response to an exponential scenario? Did the authors make some tests to see if some of the flagged profiles are just exponentially shaped and therefore maybe poorly retrieved by MAPA?

P21, L1: "...profile parameters is derived..." → "...profile parameters are derived..."

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