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Interactive comment on "Intercomparison of aerosol extinction profiles retrieved from MAX-DOAS measurements" *by* U. Frieß et al.

Anonymous Referee #1

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Frieß et al present inter-comparison of AOT and surface extinction coefficients retrieved during CINDI 2009 by five different groups (algorithms) from MAX-DOAS data, AERONET and humidity controlled nephelometer. They also compare aerosol extinction coefficient profiles from MAX-DOAS and ceilometer backscatter profiles smoothed on MAX-DOAS measurements sensitivity vertical and temporal grid below 4 km. Most algorithms use optimal estimation iterative fitting of the measured and modeled dSCD of the oxygen collision complex (O2O2). SSA, asymmetry parameter (Henyey–Greenstein approximation), and surface reflectivity are input parameters that are derived from external sources. The main conclusions of the paper: 1) MAX-DOAS AEC profiles are relatively well captured while comparing with the smoothed ceilometer backscatter profiles that have no sensitivity below 150 m; 2) relatively good correlation ($R \approx 0.8$) with the AERONET AOT but with the systematic underestimation of 10 –

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Discussion paper

30% by MAX-DOAS; 3) Surface MAX-DOAS AEC is significantly larger than the in-situ nephelometer AEC at 60 m. Good discussion of the MAX-DOAS validation difficulties is given and potential causes of disagreements. The paper is well written, clearly presents methods and results. The topic is relevant to AMT and I strongly recommend publishing the article after some modifications.

Major concern:

In my opinion the paper should address in more detail the “correction” factor of 0.8 +/- 0.1 used to decrease the observed dSCD(O2O2) to match the modeled dSCD(O2O2). This correction factor is mentioned in description of MCIP and AIOFM algorithms, but based on the previous publications, it is applied by all participating groups. Originally thought to be caused by the T-dependence of O2O2 absorption cross section, it is not supported by direct sun and airborne MAX-DOAS (Spinei et al., 2015) measurements. Recent study by Ortega et al., 2016 suggests that increase in dSCD(O2O2) is due to elevated aerosol layers. If this is the case dSCD(O2O2) have larger sensitivity to the aerosol elevated layers than it is commonly assumed and the application of the correction factor is not acceptable for aerosol retrieval. Underestimation of the MAX-DOAS derived AOT relative to AERONET is of about the same magnitude as the dSCD correction factor.

Minor comments:

Section 2.4:

What is the source of MPIC temperature, pressure and relative humidity profiles during CINDI? Using soundings launched over deBilt gives maximum VCD(O2O2) of 1.32 molecules2/cm5 vs 1.43 molecules2/cm5.

Section 3.1

Averaging kernels are the result of the OE retrieval so different averaging kernels will be produced by different groups depending on their algorithm implementation and input parameters. Since the a priori is not a true climatology, the same MAX-DOAS measurements will have seemingly different vertical sensitivities. Non-OE algorithms have no easy way to generate averaging kernels. I find it somewhat misleading to show ceilometer data convolved with the Heidelberg averaging kernels as to “what to expect” for MAX-DOAS retrievals from all groups. How do the authors define the PBL height from the MAX-DOAS aerosol profiles? Figures 4-7 show rather large variability between the groups in vertical distribution of AEC.

In my opinion it will be useful to add “lessons learned” section to elaborate on the potential improvement of MAX-DOAS aerosol validation during CINDI-2016 campaign (e.g. needed in-situ and remote sensing instrumentation, observation geometries, etc.)

Table 2 and 3:

Please add “*” to JAMSTEC data and an explanation below: * Only data points at UTC before 16:00 are reported

Figure 2. SSA and asymmetry factors from AERONET CIMEL are shown only for parts of some days. How do the groups estimate these inputs when there are no AERONET retrievals?

Figure 6. July 2 panels are not aligned with July 1 2009 panels.

Figure 7. Why the gap in ceilometer data smoothed by Heidelberg averaging kernels during noon reference (zenith) measurements is narrower than in the Heidelberg retrieval data that produced the averaging kernels?

Figure 10. It is difficult to see individual group results. I suggest having a panel with the “reference” data and then plot the differences to the reference data (maybe in percent to the reference?)

References:

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