Atmos. Meas. Tech. Discuss., 8, C602–C605, 2015
www.atmos-meas-tech-discuss.net/8/C602/2015/

Atmospheric Measurement Techniques Discussions
Open Access

AMTD

8, C602–C605, 2015

Interactive Comment

Interactive comment on "Evaluation of MAX-DOAS aerosol retrievals by coincident observations using CRDS, lidar, and sky radiometer in Tsukuba, Japan" *by* H. Irie et al.

Anonymous Referee #1

Received and published: 8 April 2015

General comments

The manuscript entitled 'Evaluation of MAX-DOAS aerosol retrievals by coincident observations using CRDS, lidar, and sky radiometer in Tuskuba, Japan' by Irie et al. presents a comparison of aerosol extinction profiles with independent in situ and remote sensing instrumentation. A main focus of their work is on the estimation of possible correction factors for the observed O_4 dSCDs, which might be necessary for an accurate retrieval of atmospheric aerosol properties.

The retrieval of aerosol and trace gas vertical profiles from MAX-DOAS measurements

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

is a strongly emerging field and the validation and improvement of the retrieval algorithms is of high importance. Therefore the subject of the manuscript is of relevance for the DOAS community and well suited for a publication in AMT. The manuscript is well written and clearly structured. The main outcome of the study is an elevation angle dependent correction factor for the measured O_4 dSCDs, for which the authors have no physical explanation, but which leads to a better agreement between MAX-DOAS and independent instrumentation. I recommend a publication in AMT after the comments below have been addressed.

A general problem of the methodology used by Irie et al. is the fact that elevation angle dependent correction factors are inferred from the disagreement between modelled and retrieved O_4 dSCDs. However, the observation of a larger disagreement at higher elevation angle is most likely not real, but due to the fact that the measurements at lower elevation angles are much more sensitive for the atmospheric state (much larger weighting functions near the surface). Thus, the retrieval algorithm will always try to bring the measurements at the lowermost elevation angles into closer agreement than at higher elevation angles, even if the discrepancy between measurement and model has other reasons.

Specific comments

Introduction: Publications on the relevance of atmospheric aerosols for the climate system should be cited (e.g., IPCC report).

1019.10: Where did you obtain the pressure and temperature variations from? Do you only have surface data or information on their vertical profile?

1019.15: The statement that the forward model should be identical to the measurement vector for a perfect inversion is incorrect. There is always measurement noise that leads to a discrepancy between measurement and modelling.

1019.17: I disagree that no prior knowledge on the absolute value of the AEC is pro-

AMTD

8, C602–C605, 2015

vided. If prior information on the AOD and the relative profile shape (i.e., fractional aerosol optical density in different layers) is provided, then the AEC is simply the product of both quantities and therefore specified implicitly.

Section 2.3: The estimation of aerosol extinction profiles from lidar backscatter signals is usually problematic since the results are very sensitive to assumptions on the backscatter-to-extinction ratio. Please add a description how extinction profiles were derived from lidar data, and a discussion of their uncertainties.

1024.16: It is stated that most aerosols are located at an altitude below 1 km, but from Fig. 2 it seems that the aerosol layer frequently extends to up to 2 km, in particular at the end of the period (after 16. October).

1026.16: Please specify what you mean with the statement that '$f_{O4} = 1.00$ brought MAX-DOAS AEC values closer to CRDS and lidar data'. How do you quantify the level of agreement? The R^2 is larger for $f_{O4} = 1.25$, and also the slope is closer to unity than for $f_{O4} = 1.00$.

1026.12: The better agreement between model and measurement at 3° elevation angle is most likely due to the larger weighting functions at low elevation, see my general comment.

1027.1: I do not understand how the discrepancy between model and measurement can be resolved by adding more or less aerosols to the model profile. The discrepancy between model and measurement should be minimised by the retrieval algorithm and if this is not possible, then this is either due to (1) a problem with the measurements (i.e., systematic biases), or (2) an erroneous forward model or (3) inappropriate a priori constraints.

1028. 14: How exactly have the effective temperatures been derived?

1030.1: There is no connection between information content and agreement between measurement and model, and an increase in DOFS does not mean that the measure-

AMTD

8, C602–C605, 2015

Interactive Comment

ments are better explained by the model. For this reason, I doubt that the accuracy of the correction factor can be assessed based on DOFS.

1031.11: I do not think that a poorer agreement of modelled and measured O_4 dSCD at high elevation angles is due to inaccurate dSCDs at higher elevations, but due to a general disagreement, combined with a lower sensitivity to the atmospheric state (see also my general comments).

Technical corrections

1020.5: 'AOD F_1' -> 'AOD x F_1'

1025.22: 'small' -> 'smaller'

Table 1: First and second row show the same numbers (or is this by coincidence?)

Figure 5: What do you mean with 'each bin of the CRDS or lidar data'? Information on slope, intercept and R^2 for the rightmost panel is missing (also in Fig. 7).

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 1013, 2015.

AMTD

8, C602–C605, 2015

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper