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## ***Interactive comment on “Performance of MAX-DOAS measurements of aerosols at Tsukuba, Japan: a comparison with lidar and sky radiometer measurements” by H. Irie et al.***

**Anonymous Referee #1**

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The paper by Irie et al. reports on MAX-DOAS measurements of aerosols at Tsukuba, Japan, from November 1 through December 21, 2006. The MAX-DOAS O4 DSCD were utilized to retrieve aerosol optical depths and vertical profiles of the aerosol extinction by optimal estimation methods. Aerosols play an important role in the radiation budget as well as in the chemistry of the atmosphere. The paper describes the application of a valuable new remote sensing technique to retrieve aerosol properties. Thus, the paper is relevant for atmospheric chemistry and physics.

The retrieval was performed for the period of 51 days which provides a comprehensive dataset. For evaluation of the retrieval, the aerosol extinction was compared with Li-

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dar measurements and the aerosol optical depth with sky radiometer measurements, both at the same site. For most cases, the comparisons show intriguing agreement. Furthermore, for 4 days in the beginning of November O4 DSCD were modeled and compared with the measurement, which also shows good agreement. The paper is well organized, clear and written in detail. I recommend the publication after revisions outlined in the following sections:

Since the authors present a very new technique which is not yet approved to deliver reliable results sensitivity studies are necessary. The authors have already performed such studies on several parameters. But to my mind, it is indispensable for publication of this paper that sensitivity studies on the a priori values as well as on the a priori errors are presented. There is no information how much of the retrieval is actually derived from the measurements and how much is the a priori input for the lowest two air mass layers. Furthermore, error bars in Figures 4,6,7,8 and 9 as well as enlarged Figures (except for Fig. 1 and 3) would help the reader to evaluate the retrieval. Maybe, in terms of Fig. 6 and 8, additional plots with the comparison of the 4 chosen days could be useful. Moreover, a direct comparison of Fig. 2 and 4 would be highly appreciated.

Minor comments:

- P. 9774, l. 2: There is a space character too much.
- P. 9774, l. 16/17: The definition of partial optical depths by  $F_1$ ,  $F_2$  and  $F_3$  seems to be more complicated than necessary. Can the authors transform them (to e.g.  $G_1 \cdot \tau$  for layer 1,  $G_2 \cdot \tau$  for layer 2,  $G_3 \cdot \tau$  for layer 3 and  $G_4 \cdot \tau$  above) at least for the illustration of the averaging kernels in Fig. 3? The Figure would be more comprehensible.
- P. 9777, l. 18ff: The comparison of the aerosol extinction from MAX-DOAS, which is derived by the Lidar data as a priori values, with the Lidar data itself might lead to a bias in the evaluation. Please insert a comment on that.
- P. 9778, l. 7/8 and p. 9779, l. 8-10: The differences of the integration times of the

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MAX-DOAS measurements and the Lidar/sky radiometer could easily be overcome by averaging the data of the Lidar/sky radiometer according to the respective MAX-DOAS measurements. Is there a reason why this has not been done?

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