

## ***Interactive comment on “MAX-DOAS retrieval of aerosol extinction properties in Madrid, Spain” by Shanshan Wang et al.***

**Anonymous Referee #2**

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The paper discusses the results of aerosol extinction vertical profile and AOD retrievals over Madrid, using MAX-DOAS O<sub>2</sub>-O<sub>2</sub> (O<sub>4</sub>) measurements in the UV for a period of several months in 2015. The results are validated with sun photometer and PM surface data. A Saharan dust event is analysed in detail.

The paper is clearly written. The methods used are well-known and described in sufficient detail. The results are interesting, and are relevant to using MAX-DOAS for aerosol detection and profiling.

The main comments are the following:

1. As discussed in the paper, esp. in sect. 4.1, the a priori aerosol profile is very important to get a good profile retrieval, and a good AOD value from the retrieval. It appears that an exponential profile works well for urban aerosols. However, this

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exponential profile type is not realistic for a desert dust plume, which is an elevated layer of aerosols, including aerosols at altitudes above 4 km. This means that for desert dust events, like the one discussed in Sect. 4.4, another a priori profile should be used in order to get meaningful retrievals from MAX-DOAS retrievals. Please discuss this point, and extend the work of Sect. 4.4 for a Gaussian plume profile of an elevated dust layer.

2. It would be better to use an aerosol lidar for validation of MAX-DOAS aerosol extinction profiles. The AOD gives only the total column, and the surface concentration is only one point of the profile. Please discuss. Are there no lidars or ceilometers available in Madrid?

3. Use of satellite data, as mentioned on p. 9, l. 22: Daily satellite images of desert dust, visualized with the Absorbing Aerosol Index (AAI) are available from OMI and GOME-2 satellite data. See e.g. the TEMIS website: [www.temis.nl](http://www.temis.nl), and go to Aerosol Index. These satellite images may help to select desert dust plumes and other elevated plumes of absorbing aerosols.

Minor comments including textual corrections are:

p. 1, l. 15: by particle > by aerosol particles

p. 1, l. 26: of the aerosol's role > of the role of aerosols

p. 2, l. 20: the NO<sub>2</sub> > NO<sub>2</sub>

p. 2, l. 24: vertical aerosols > vertical aerosol

p. 2, l. 28: please specify the period. It is a matter of taste, but a few months is not long for a meteorological time series.

p. 3, l. 9: responsible to run > running (storing); which offset is meant?

p. 3, l. 12: the saturation > saturation

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p. 3, l. 18: azimuth angle w.r.t. North

p. 3, l. 30: reformulate: ... if the relative errors as found from QDOAS were less than 10 %.

p. 4, l. 28: measurements  $y_m$

p. 4, l. 30 ff: explain chi square. Please use bold type for vectors and matrices. Please explain how  $y_m$  is linked to the vector  $y$ .

p. 5, l. 27: consecutively

p. 6, l. 6: Thalmann > Thalman. This occurs at more places in the paper.

p. 6, l. 24: a priori > a priori profile (this occurs at more places).

p. 7, l. 10: in vertical > in the vertical (this occurs at more places).

p. 7, l. 29: monthly > daily ?

p. 7, l. 29 – 31: please write out the hourly, daily and monthly correlations more clearly, in separate equations, as important results of this paper.

p. 8, l. 8: where does the 20 % come from?

p. 8, l. 14: the ground surface, the vertical

p. 8, l. 25: include:

p. 9, l. 5: metropolitan area

p. 9, l. 24: intrusions

p. 9, l. 25: display

p. 9, l. 27: found that

p. 9, l. 33: retrieved aerosol profiles and corrected profiles

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p. 10, l. 16: remove: during day. Please make clear that Fig. 9 contains model AOD fields.

p. 10, l. 24: a cross-section scaling factor

p. 10, l. 28: exponential a priori profile

p. 14, l. 4: Stutz

p. 15, l. 2: quality

Figures:

Captions of Fig. 6 and Fig. 7: extinction > aerosol extinction

Fig. 1: please give the lat/lon coordinates as well.

Fig. 2: please order the lines according to increasing scaling factor. Please use a different color for the line with 1.25, since that color is too similar to red (line with 1.0). Please also show the SZA .

Fig. 3: In b the two red colors are too similar.

Fig. 4: please add a scatter plot to better see the ratio of MAX-DOAS AOD to Aeronet AOD.

Fig. 5: The figure contains a lot of double information. Please consider omitting figure (a).

Fig. 6: please indicate in the legend whether hourly or daily data is shown.

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