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Interactive comment on "**An exploratory study on the aerosol height retrieval from OMI measurements of the 477 nm O$_2$–O$_2$ spectral band, using a Neural Network approach**" *by* **Julien Chimot et al.**

Anonymous Referee #2

Received and published: 10 January 2017

The paper examines retrievals of aerosol optical thickness and layer pressure (height) from OMI spectral measurements (or as applicable to other instruments) of the O2-O2 absorption band near 477 nm using a neural network approach. A detailed analysis is carried out using simulated data. The approach is then applied in different ways using OMI and MODIS data over land areas of Asia with relatively high aerosol loading and compared with a lidar-based data set (LIVAS).

This is a detailed paper that should be published in AMT. The paper is in general clearly written though there are a number of typos and grammatical issues that it is assumed

will be caught during the copy-editing of the manuscript. Only a very few are listed below. I agree with the comments of reviewer 1 and add some additional comments for minor revisions below (some of these may be duplicates).

The last sentence of the abstract - "This study shows the first encouraging aerosol layer height retrieval results over land from satellite observations of the 477 nm O2-O2 spectral band." - is correct as written. However, the authors may mention here that a previous study examined case study retrievals over ocean. This sentence may stick in the reader's head as this is a "first" implementation with real data (references are later given and it becomes more obvious that these are the first results shown with data over land). I had to go back and reread the sentence to find the over land part, which makes it correct.

It might be better to include up front a Data section with the various satellite data sets used (OMI, MODIS, LIVAS) rather than to mention them in different places (and not referenced at the first mention - LIVAS). As it is OMI is mentioned in its own section section with MODIS mentioned below in the Methodology section. It seems that MODIS is an important part of this study as it is important to get accurate ALH and perhaps it deserves more attention.

P. 2, L. 34, here and also elsewhere suggest to add e.g. before references as there are others not in this list.

P. 3., L. 20, please add Torres et al., 1998 before de Graaf reference, also suggest to add Torres et al., 2013 reference here and explain that monthly climatology of CALIOP aerosol heights are currently in use for determination of aerosol parameters from OMI UV measurements.

P.4, L. 2, please add appropriate references here (altogether, though they are listed above).

Section 2.3, 1st par., This information may go better in the introduction. It's not clear

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why MAX-DOAS is mentioned specifically here (this sentence seems out of place and not necessary). May be useful also to mention the work of using O2 A-band to retrieve aerosol height (over ocean by e.g., Dubuisson et al. 2009) and discuss possible advantages of the O2-O2 band (lower surface albedos over land?) and also discuss availability of these bands on various sensors such as OMI, OMPS, GOME-2, TROPOMI.

P. 9, L. 6, I think "either" should be removed as it is confusing.

Sect. 5.1, Perhaps I missed it but I do not see where the area of North-East Asia is defined. Please give the latitude-longitude of the area studied and/or show it on a map. I believe the highly industrialized areas (where there is heavy aerosol loading) used in this study may also be referred to as South-East Asia, thus it can be confusing.

P. 15, The discussion of the pairing of OMI and MODIS is confusing. It should be made clear that the resolution of MODIS is 1 km or better, but that collection 6 aerosol products are available at either 3 or 10 km resolution and that you are using 10 km. Please mention that you are using dark target only if this is the case and mention the specific product name, e.g., MYD04_L2. I believe that data are provided within the 10 km grids if they have some amount of cloud free pixels, so there may still be clouds present within the given area even when MODIS data are reported. Also, the 10 km x 10 km areas should not be referred to as a pixel as this can be confused with native MODIS pixels. Does the MODIS geometric cloud fraction used come from the aerosol product? This should be clarified as there are multiple MODIS cloud detection algorithms.

P. 15, L 24, change of to or.

Please check the English meaning of referent. It is defined in most English dictionaries as a noun but used in the paper primarily as an adjective. I believe the word reference may serve better in most instances and also perhaps the word default.

P. 17, L. 19, accuracy of OMI tau retrievals with respect to MODIS.

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P. 18, L. 29, remarkable agreement with respect to seasonal mean values

Table 1: What happens for surface pressures < 963 hPa. The neural net will be extrapolating. How well will it do this? Does this occur with the real data? Likewise, why not add a node with single scattering albedo of unity? Also, the maximum value of VZA for OMI is > 44.2 degrees, so why not include the full range?

Table 2: When providing values for delta NsO2-O2 it would be good to provide a percentage error for these for a given scenario (readers will not have a good idea as to how large these values are). Perhaps I missed it but doing a search of "table" doesn't turn up a reference to Table 2 from the text. The aerosol optical thickness error is quite large for a change in surface albedo of 0.05. If surface albedo errors are more of the order of 0.02 (as stated in the text) then perhaps this would be a more appropriate value to use.

All figures in general would benefit from larger fonts. Also the tau in the figures looks different enough from the tau in the text to be somewhat confusing.

Figure 3 caption is confusing. What exactly is the supervised data set (training-validation-test)?

Figure 4, again lines and symbols hard to distinguish. It would be helpful to mention in the caption that the scenarios for the lines with the dot symbols tend to tall on top of one another.

Figure 6: Something should be mentioned in the caption about the range of surface albedos (Alb) used (same for several other figures).

Figure 9: I don't see where it is stated that the dotted line is the 1:1 line.

Fig. 10: There are many lines on these plots. It would help the reader if the 1:1 lines were made thicker to distinguish them. There are backward brackets in the legends at the ends of lines.

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