

Interactive comment on “Determination of an effective trace gas mixing height by differential optical absorption spectroscopy (DOAS)” by B. Zhou et al.

M. Van Roozendael

michelv@oma.be

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Referee's report

Manuscript no. AMTD-2-1663/2009 Authors: B. Zhou, S.N. Yang, S.S. Wang, and T. Wagner Title: Determination of an effective trace gas mixing height by differential optical absorption spectroscopy (DOAS)

General comments

In this paper a new method is proposed for the determination of an effective mixing height in the planetary boundary layer (PBL). The method is based on the simultane-

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ous measurement, using a combination of passive and active DOAS techniques, of the surface concentration and the integrated vertical column of NO₂. Assuming that NO₂ is well mixed in the PBL, the ratio of the column to the surface concentration provides a good estimate of the effective mixing height (ETMH) for this short-lived trace gas. One year of ETMH measurements performed in Shanghai are presented. Comparisons with climatological values of the mixing height available for Shanghai show that main expected features are reproduced by the new technique. However the method is found to be limited in accuracy during winter when the NO_x lifetime is longer and local conditions can be perturbed by transport of pollutants from distant sources. In this case the ETMH method tends to overestimate the true mixing height. Despite these limitations and although more work is needed to fully appreciate the range of application of the ETMH method, the proposed new approach clearly represents an innovative and potentially useful development of the already well established DOAS technique. I recommend publication of this work in AMT after attention to the specific remarks listed below.

Specific comments

P. 1665, L. 3: add a reference for the importance of MH determination in air quality modeling. It might also be interesting to mention to degree of accuracy that is necessary for such model validation or for use as an input. Does the new method matches the required accuracy?

P. 1667, L. 18 and Figure 3: I find this way of presenting results not very efficient. Why not simply show the diurnal variation of the retrieved ETMH for this particular day (only one plot would be necessary to do this) and explain that it is consistent with expectations?

P. 1668, L. 5: If Figure 3 is modified according to me previous suggestion, it will be easy to show results for the two different assumptions (constant concentration or constant mixing ratio) and to demonstrate that the impact is small.

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P. 1675, L. 9: please expand of this. In which way the simultaneous measurement of different molecules will bring information on their respective lifetimes ? Is it through the resulting differences in profile shapes that will affect the determination of the ETMH. If this is the idea, explain how such differences can be quantitatively converted into the lifetimes.

Figure 5: Also May data are suspicious in this plot. Explain the possible reasons for it.

Figure 8: the last sentence of the caption is unclear. Explain that values are unrealistically high probably because of the occurrence of a second NO₂ layer due to transport from distant pollution sources.

Figure 10: these plots are too small and impossible to read.

Comments of editorial nature:

Overall the clarity and readability of the manuscript could be improved with the help of a native English speaker.

P. 1666, L. 11: replace “substantial” by “substantially”.

P. 1666, L. 16: remove “of” between “analyzing” and “the integrated”.

P. 1667, L. 20: replace “VCD_EMTH” by VCD_ETMH”

P. 1668, L. 1: replace “To reduce a possible cloud influence . . .” by “To reduce the possible influence of clouds on . . .”

P. 1670, L. 14: for the sake of clarity, please reformulate the sentence “. . . , which illuminates the ETMH variation is opposite to temperature, . . .”

P. 1670, L. 19: replace “Table 3 show . . .” by “Table 3 shows . . .”

P. 1671, L. 20: replace “The second point can become important especially . . .” by “The second assumption might not be fulfilled especially during winter . . .”

P. 1672, L. 13: reformulate this sentence, e.g. “In a recent analysis covering 15 years
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from 1990 until 2004, Yang et al. presented of MH variations determined in Shanghai at 2:00, . . .”

P. 1672, L. 18: replace “. . . , they might well be representative . . .” by “. . . , the can be considered as representative of . . .”

P. 1673, L. 1: remove “is” between “occurs” and “at”

P. 1673, L. 14: replace “. . . in the free troposphere is 2 of that . . .”, by “. . . in the free troposphere is twice as low as in the mixing layer . . .”

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