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Atmospheric Measurement Techniques Discussions

Interactive comment on "Potential and limitations of the MAX-DOAS method to retrieve the vertical distribution of tropospheric nitrogen dioxide" *by* T. Vlemmix et al.

Anonymous Referee #2

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The paper presents an extensive analysis of the potential of MAX-DOAS measurements for retrieving vertical profiles of NO2. It is well written and matches the scope of AMT. It should be published after minor revisions:

General comments

1. The authors investigate the effects of the choices for several free parameters on the inversion. In practice, however, the first choice when performing MAX-DOAS measurements is on the number and values of elevation angles. Within this study, they are fixed (2,4,8,16,30,90) without any discussion and without the announced reference

(4020/12). Please add a motivation for this particular choice and discuss, how far a different choice (additional angles?) might improve the inversion performance. Also comment on the required accuracy of elevation angles.

2. The inversion approach is simple and transparent; however, several groups use OE for the retrieval of profiles. Please discuss the differences in approach and results of both methods; how far could groups using OE still learn something from your study?

3. In the introduction, you point out the importance of profile information for the validation of satellite retrievals. Please refer to this aspect in the conclusions: How far are MAX-DOAS measurements and the presented inversion algorithm suited to validate/improve satellite retrievals?

Further comments

4014/6: Replace "in which MAX-DOAS retrievals play a role" by "of satellite observations".

4014/11: What are "retrieved model uncertainties"?

4014/15: "The height of the elevated NO2 layer can only be retrieved": This sounds as if the height of the elevated layer is a free parameter, but it is fixed within this study.

4018: Add a reference to Wagner et al., AMTD, 2011, http://www.atmos-meas-tech-discuss.net/4/3891/2011/amtd-4-3891-2011-discussion.html.

4019/7: Replace "successfulness and limitations" by "performance".

4023/20: Due to the different lifetimes of aerosols and NO2, the elevated layer heights could be different for both, which would probably affect the inversion. Please comment on that.

4025/10: Please discuss how far additional measurements in the UV might provide additional information and improve the inversion.

4029-4030: The procedure is somewhat tenuous: First you vary the input to learn something on uncertainties, but then you skip those results you don't like. For a measurement, where the truth is not known, extreme values can not be identified and skipped that easily!

4035/2: molec cm-2

4035/5: The effect is relatively small for AOT=0.2; for polluted regions (China), however, it can probably be much higher!?

4040/4: "suspect": Be more specific! Have there been clouds, e.g. in the BSRN?

Table 1: Maximum AOD is 1, which might be exceeded over China!

4071/5: molec cm-2

Figure 14: Linear regression assumes an independent and a dependent variable; this is not the case here, and both lidar and MAX-DOAS have errors. Please apply an appropriate method (see Cantrell et al., 2008, ACP, http://www.atmos-chem-phys.net/8/5477/2008/acp-8-5477-2008.pdf).

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 4013, 2011.