**Atmospheric
Measurement
Techniques**
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Discussions

Interactive comment on "The use of NO_2 absorption cross section temperature sensitivity to derive NO_2 profile temperature and stratospheric/tropospheric column partitioning from visible direct sun DOAS measurements" *by* E. Spinei et al.

Anonymous Referee #1

Received and published: 24 July 2014

This paper presents a method called TESEM (TEmperature SEnsitivity Method) to retrieve atmospheric slant $NO2$ profile-weighted temperature T from ground-based direct-sun (DS) DOAS measurements. This method, based on the temperature dependence of the $NO2$ cross-sections, is also used to separate stratospheric and tropospheric columns from the measured DS total columns. TESEM is applied to DS measurements performed at four mid-latitude sites with low and moderate $NO2$ pollution. This

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Interactive Discussion

Discussion Paper

work is a valuable contribution to the DOAS research field and it offers new perspective on the use of DS observations for satellite data validation.

The paper of Spinei et al. is well written and clearly structured and the method and results are presented and discussed in an appropriate and balanced way. Therefore I recommend the paper for publication in AMT after addressing the following comments:

Main concern:

The method seems to work well at the four selected sites. However, to my opinion, its validity is not fully demonstrated in the paper. In order to achieve that, comparisons with correlative data sets would be helpful. A comparison between retrieved and modelled stratospheric NO2 VCD is presented in Fig. 10 for the WSU/Pullman site but since at Cabauw and WSU/Pullman almost coincident MAX-DOAS observations exist, I wonder why you did not use these data to verify your tropospheric NO2 columns. In a first attempt, you could use the MAX-DOAS tropospheric NO2 columns derived by the geometrical approximation. Moreover, if you have twilight zenith-sky observations at these both stations, you could also derive stratospheric NO2 columns and convert them to the DS measurement times using your GMI model in order to validate/verify your TESEM stratospheric columns.

Specific comments:

Abstract: The abstract is a bit too long to my opinion. I suggest to move the paragraph on the traditional NO2 fitting in the Introduction.

Page 5705, line 6: Please replace $T_0=0^{\circ}C$ by $T_0=273$ K in order to be consistent with Fig. 3.

Page 5707, lines 20-21: please add a reference for the MLE method.

Page 5711, Sect. 5: The error sources are briefly discussed here. I think it would be interesting to provide an error budget on the retrieved tropospheric and stratospheric NO2 columns. I suggest to include a table with the different error sources and their

corresponding uncertainties. Also related to this point, I think it would be interesting to see error bars in Fig. 10.

Page 5719, lines 15-25: You applied your method only to mid-latitude sites in late spring/summer. Do you expect larger uncertainties in fall/winter ? What about the application of your method to highly polluted sites, e.g. in or in the vicinity of megacities ? Please clarify the possible limitation(s) of your method.

Technical corrections:

Page 5697, line 16 and page 5707, line 5: the use of Ts for the plural of T is confusing, please try to avoid that.

Page 5703, line 7: T should be in italic.

Page 5707, lines-20-21: '(MLE, Eq. (7)' should be replaced by '(MLE, see Eq. (7))'.

Page 5727, step 2, second column: 'SCDref' instead of 'SDCref'.

Page 5740, Fig. 10: Right y-axis are missing in the second and third right plots. Could you please put the dates on the upper left corner of the plots to avoid a mixing with the axis legends. Similar comment for Fig. 8.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 5695, 2014.