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Atmospheric Chemistry and Physics Discussions

Interactive comment on "High spatial resolution measurements of NO_2 applying Topographic Target Light scattering-Differential Optical Absorption Spectroscopy (ToTaL-DOAS)" *by* E. Frins et al.

E. Frins et al.

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Reply to Referee # 1

Interactive comment on "High spatial resolution measurements on..." By E. Frins et al.

The authors would like to thank the referee for the constructive review. Before we answer in detail the referee #1 comments and indicate in detail the incorporated changes (see below), we want give a short overview on the major changes in the revised version of the manuscript.

1) We conducted additional measurements with the new technique. We selected the

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same location and viewing geometries as for the first measurements in order to ensure a consistent interpretation. We made measurements during two days in August and September 2008 covering each a period of about 2-3 hours (the time we could operate the system without external electrical power. The new data sets in general confirm the findings of the initial data set. In addition important information on the internal consistency and the retrieved NO2 mixing ratios from measurements at different targets could be derived. As expected the fluctuation of the results for the closest target were largest confirming the expectations of the effect of the absorption paths above the instrument and target.

2) We added a new section (2.3) on the determination of the measurement uncertainty and detection limit from the DOAS analysis.

3) We added an individual section on the measurement results (new section 3) and we added two new figures showing the results for the additional measurements.

Detailed response:

The manuscript by Frins et al. presents a new setup of Total-DOAS for NO2 measurements. The ideas of Total-DOAS are based on the findings in a previous paper by the same authors (Frins et al., 2006). The new aspect of the manuscript at hand is the use of Total-DOAS at short light paths in a polluted environment. The current study contains 8 measured data points only. These are not compared to any other NO2 measurement technique. In addition, there is no information about meteorology or trace gas concentrations available which allows the reader to assess the presented data. It is not clear to me what causes the variation of the 8 values recorded during a 1-h time interval.

Author's reply: Unfortunately, there are no other methods available for doing comparative measurements. Despite this, we think that important conclusions can be drawn from the internal consistency of our own observations. This is now discussed in much more detail in the (new) section on results (section 3) and the section on discussion

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and conclusion. We also conducted additional measurements and found good consistency of the results for the different targets. We think that these findings provide reasonable evidence for the usefulness of the proposed method for measuring trace gas concentrations at short light paths.

The term "High spatial resolution" in the title refers to the possible measurements of small absorbances. The error in the slant column (Table 1) is 3.6x10ˆ14 cmˆ2 only, corresponding to an absorbance of about 10ˆ-4. This value should be justified (e.g. by a plot of the residual) and discussed on the basis of the findings of Stutz and Platt (1996).

Author's reply: We added a new section (2.3) with a detailed discussion of the measurement errors as suggested. The reference to the paper by Stutz and Platt is added.

The discussion on the influence of the extension of the NO2 cloud (Figure 3ad) is vague and not supported by any measurement like meteorology or trace gas concentrations at the instrument S or at the target T.

Author's reply: We agree with the referee that the discussion on the influence of the extension of the NO2-cloud (Fig. 3) is simplistic. But the intended purpose of Fig. 3 was mainly of didactical character, with the aim to clarify the underlying assumptions of our method. Nevertheless, especially from the new measurements important conclusions on the effects of the homogeneity of the NO2 concentration field could be drawn (see new section 3), which confirm the expectations from the discussion about the effects of the plume shape. Basic information about meteorology (weather conditions) is now included in the revised manuscript.

I do not recommend to publish the current manuscript in ACP. However, the Total-DOAS technique can become a valuable tool for measurements of NO2 and other trace gases when the pros and cons of the technique are discussed on the basis of a more conclusive dataset.

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Author's reply: We realize that additional work might be necessary to fully exploit the advantages and drawbacks of ToTaL-DOAS. Despite this, we think the especially with the additional measurements we could demonstrate that the underlying idea is sound. We are confident that our initial work can evolve into a valuable tool for measurements of NO2 and other trace gases, and that the present work is a step in that direction. We hope the revised manuscript version meets the referee's requirements.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 10257, 2008.

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Interactive Comment