

Interactive comment on “MAX-DOAS detection of glyoxal during ICARTT 2004” by R. Sinreich et al.

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Received and published: 17 November 2006

The paper by Sinreich et al. reports on observations of glyoxal (CHOCHO) using ground- and shipbased MAX-DOAS measurements during the ICARTT campaign in 2004. The measurements from the ground were carried out at MIT, Cambridge, USA, those from the ship on board the research vessel Ron Brown in the Gulf of Maine. The study focuses on a limited data set: One day in July 2004 for each instrumental platform. However, since only a very few measurements of glyoxal in the atmosphere have been published so far it contains significant and new information on this trace gas. The paper is in general clearly written and I recommend it for publication in ACP. But the authors should address for some revisions/corrections as detailed below, most of them are technical/editorial.

General comments:

- There is only one major point the authors should address in their revised version. Since this paper is on the theoretical aspects of the MAX-DOAS detection of glyoxal more information and in particular more figures are necessary to illustrate the profile inversion in section 4. Similar information is given in Sinreich et al., 2005. However, the reader will have a more thorough overview on this important topic, which makes the section 5 (Results) more useful. I propose to add following:

One example showing modeled and measured O₄-DSCDs for one day., e.g. for the hourly averages shown in figure 3. Do the authors have taken into account all elevation angles of the MAX-DOAS to analyse the aerosol?

Please add a statement on the possible influence of the aerosol type on the retrieval. This might be also one reasonable explanation for problems in aerosol modeling for measurements on board RV Ron Brown on July 17th 2004. The explanation given in the manuscript "... due to the relatively high AOD" is not very conclusive since an AOD of 0.2 is quite common above the oceans.

- The authors have used the ratio of 3° and 18° DSCDs to estimate the mixing layer height for CHOCHO. This is of course a suggestive approach but the authors should point out more clearly that this is based on the assumption that all of the CHOCHO is well-mixed within one single layer which is probably not the case in reality (see e.g. Heckel et al., 2005). In fact, the same argument is true for the aerosol profile (see comment on figure caption 2 below). The authors might add a statement that a future retrieval algorithm will profit from the measurements at all different elevation angles and therefore provide more profile information.
- One obvious question by reading this paper is: What is the reason that no measurements of HCHO are presented? The retrieval of O₄ in the UV already includes formaldehyde and this trace gas would provide valuable information on the interpretation of the glyoxal observations.

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- It would be worthwhile to add information on the vertical columns of CHOCHO during the ICARTT campaign. If possible for more than one day since this pulls the manuscript together with the satellite work.

Minor corrections/comments:

- Abstract, line 6: The authors should take into account, that in Wittrock et al. not only satellite measurements are shown but also MAX-DOAS measurements have been used for validation. Therefore the statement “we report the first detection of CHOCHO by ...” should be rephrased slightly. The same is valid for page 9461, line 15 (Introduction).
- Abstract, line 16: “The paper focuses on the instrumental aspects ...”. If this is true, I wouldn’t recommend this study for publication. There is no special instrumental requirement necessary to observe glyoxal with the MAX-DOAS technique. Please skip this sentence or rephrase it.
- Sometimes the authors did not introduce all acronyms before they are used the first time (e.g. MIT, MCMA).
- I agree with reviewer Thomas Kurosu that a lot of references should be deleted, e.g. most PhD and Diploma theses. If no other peer-reviewed reference is available on a certain topic one might add a link with access to any time e.g. <http://deposit.ddb.de/cgi-bin/dokserv?idn=962363928> (Dissertation Udo Frieß).
- Introduction, page 9462, line 7 - 12, please add Wittrock et al., 2004 and Heckel et al., 2005 since these publications illustrate the retrieval of trace gas profiles from MAX-DOAS observations.
- Introduction, page 9462, line 14 - 26: The primary quantities for ground-based DOAS measurements are differences of slant column densities (DSCD)! They

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have to be converted to vertical columns (VC) by the means of differences of air mass factors (DAMF). Please rephrase the paragraph making this more clear. The same is valid for the description of “The DOAS analysis” and some other text passages.

- Introduction, page 9462, line 29: Information on measurement sites not used in this study is not very meaningful.
- DOAS analysis, page 9465, line 11: This is definitely true for NO₂ but in case of CHOCHO stratospheric contributions are unlikely.
- Page 9466, line 16: Why O₄ was not fitted including the absorption band at 380 nm? A fitting window more to the visible should give a better sensitivity to the aerosol and reduces possible interference with HCHO, BrO and ozone.
- Figure 2: Again, no SCDs but DSCDs are shown here. Please add information on the solar zenith angles during the day. The variation of the O₄ on July 17 (Ron Brown) with sometimes smaller values in the 3° direction than in the 6° and 10° indicates a more complex aerosol profile than assumed in the retrieval. What is the reason for the very high NO₂ for large SZA (in particular in 18° direction) on board RV Ron Brown? Stratospheric contribution since the zenith sky measurement is not close enough to the off-axis?
- Figure 3 and 4: It might be useful to combine these figures and add information on the vertical column of CHOCHO (see comment above) and the solar zenith angle.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 9459, 2006.