Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-156-RC1, 2016

Atmospheric Measurement Techniques Discussions
Open Access

Interactive comment on "Parameterization retrieval of trace gas volume mixing ratios from airborne MAX-DOAS" *by* Barbara Dix et al.

Anonymous Referee #2

Received and published: 5 October 2016

This paper describes a parameterization retrieval of volume mixing ratios (VMR) from differential slant column density (dSCD) measurements by airborne multi-axis differential optical absorption spectroscopy (AMAX-DOAS). In this method, limb spectra (elevation angle 0°) are analysed using appropriate reference spectra that cancel out column contribution from above and below the instrument, so that the resulting dSCDs are for a large extent only sensitive to the atmospheric layers around instrument altitude. The conversion of limb dSCDs into VMRs is performed by using box-air mass factors calculated for a Rayleigh atmosphere and applying a scaling factor constrained by O4 dSCDs to account for aerosol extinction. In a first step, the parameterization scheme is tested on simulated dSCD data for different trace gas (BrO, IO, and NO2) and aerosol vertical profiles. Then, BrO, NO2, and IO VMRs are retrieved from measurements from the TORERO field experiment. The retrieved dSCDs are found to compare well with

Printer-friendly version

Discussion paper

optimal estimation-based retrievals. Overall, it is concluded that the uncertainty related to the parameterization retrieval is of 0.05 pptv (20%) for IO, 0.5 pptv (30%) for BrO, and 10 pptv (30%) for NO2.

This study fits well with the scope of AMT and the paper is clearly written and structured. Therefore I recommend it for final publication in AMT after addressing the following comments:

General comment:

One of the key points of the parameterization method proposed by Dix et al. is the selection of appropriate reference spectra which are close enough in time (or SZA) with the limb spectra, so that the contributions from above and below the instrument altitude are cancelled out and therefore the resulting limb dSCDs is only representative of the atmospheric layers close to the instrument altitude (the so-called sensitivity range S in the manuscript). However, when applying this method to measurements from the TORERO field experiment, the authors used one fixed reference spectrum per flight (see page 25, lines 23-24). This means that except for the limb spectra recorded close to the reference spectrum, there is always a significant difference in SZA between reference and limb measurements. So, most of the time, we are potentially in conditions where the dSCD contributions from outside the range S is significant, making the retrieval less accurate. The authors should explain why they proceed like this, instead of analysing each limb spectrum with the closest zenith or EA10° spectrum as reference. A useful and interesting test would be to compare VMRs retrieved using fixed and 'closest in SZA' reference spectra.

Specific comments:

Page 4, line 15: the upper layer of the sensitivity range S should be no more than 3.5km above the altitude layer of the instrument. The authors should justify this upper limit value of 3.5km.

Page 9, lines 20-23 and figure 2: Where these aerosol extinction profiles come from ? Any reference(s) ? If not, the authors should explain how they constructed them.

Figure 8 and Section 5.3: correlations of TORERO AMAX-DOAS BrO, IO, and NO2 VMR data retrieved by parameterization and optimal estimation are shown and discussed only for a selection of flights. Why data from all 17 flights are not plotted ? Why the selected flights are different for BrO and IO on one side, and NO2 on the other side ?

Figure 9 and Section 5.4: BrO and IO VMR profiles retrieved for all 17 TORERO flights are shown. Why a similar plot for NO2 is neither included, nor discussed in the manuscript ?

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-156, 2016.