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Atmospheric Measurement Techniques Discussions

Interactive comment on "Rapid methods for inversion of MAXDOAS elevation profiles to surface-associated box concentrations, visibility, and heights: application to analysis of Arctic BrO events" *by* D. Donohoue et al.

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The manuscript by Donohoue et al. describes three inversion methods used for analyzing Arctic BrO events from MAX-DOAS measurements. Good agreement was found for surface-associated BrO VCD derived from the box profile method, the elevated viewing method, and the horizon viewing method. These results are quite interesting. In addition to the comprehensive set of MAX-DOAS inversion methods, it might be helpful for the readers when the authors would address the following points in more details.

At which wavelength has the TRACY-II simulation been performed? For an aerosol profile retrieval, in order to receive a good sensitivity, the RTM simulation is usually performed at wavelengths where O_4 shows peak absorptions, e.g. 360 nm and 475 nm. The same principle should hold for BrO profile retrieval. In this work, it seems that the author only chose one single wavelength for the RTM simulation. If this wavelength was chosen at where only O_4 but not BrO shows peak absorption, will it introduce a systematic error on the retrieved BrO profile, and vice versa? It might be helpful to the readers to know how large the systematic error could be.

The authors used 90 different aerosol vertical distributions for the calculation of Box-AMF. However, it is not described how BrO distribution was treated in the BoxAMF calculation, considering the fact that the BrO absorption will also influence the radiative transfer processes.

From line 14 to line 25 (page 4655), the authors describe the contour plots of O_4 SA-VCD$_{EST}$. These contour plots, however, can be misleading for readers, because the vertical distribution of O_4 is proportional to the square of O_2, depending on the pressure and the temperature in the atmosphere. If the aerosol extinction changes, as long as the pressure and the temperature profiles are fixed, the O_4 VCD will remain the same. From this point of view, there should not be any dependence of O_4 SA-VCD$_{EST}$ on aerosol extinction. This independence can also be seen from Eq. 1. When aerosol exists, the effective light path of photons will change the AMF and the observed SCD in the same way.

In line 7 (page 4657), the authors describe a *four cloud classes*. What is the exact definition of each cloud class? Moreover, in lines 1 – 3 (page 4658), why only three but not four cloud types are associated with a certain error?

From line 12 (page 4657) to line 3 (page 4658), the authors describe the errors of the BrO SA-VCD. It would be helpful for the readers to clearly distinguish between the systematic errors (which come from the uncertainty of cross sections used in the DOAS

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fit, the uncertainty of the TRACY-II input parameters, etc.) and the random errors (e.g. error from the least square fitting).

Lines 17 – 20 (page 4657). The DOAS fit algorithm used by DOASIS, WinDOAS and QDOAS are nearly the same, especially WinDOAS and QDOAS are using the same code. So, why can the error originating from the fit program be as high as 7%?

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 4645, 2010.