This paper resents a novel experimental method for the rapid measurement of the horizontal distributions of trace gases near the surface by MAX-DOAS. While extended from the work of Sinreich et al. (2013), the method in this study includes several important modifications and improvements, compared to the original one. The authors constrain the MAX-DOAS measurements at the 1° elevation angle, which have an advantage to obtain information of trace gases and aerosols close to the ground. With a radiative transfer model, the authors derived the formulas to calculate the effective light path length for selected trace gases using the simultaneously measured absorption of O_4 and provide the correction factors for calculating the trace gas mixing ratios according to the retrieved O_4 dAMF of a given measurement. The authors also validate their method by observations of a newly developed GM-DOAS instrument at a suburban site near Heifei City in China. The work is expected to make a valuable contribution to the extensive application of MAX-DOAS technique to air quality research. The manuscript is well written in general and can be accepted for publication in AMT after minor revisions as suggested below.

Calculation of the correction factor f_{corr} appears to be an important step in the retrieval of trace gases VMR in this study. However, for this reviewer and perhaps other readers who are not so expert in the RTM and vertical profile inverse, the method for calculating f_{corr} seems not to be clearly presented in the manuscript. While it is clear to see that the primitive equation

$$f_{corr} = \frac{c_{retrieved}}{c_{real}} = \frac{dSCD_{tracegas}}{L \cdot c_{real}}. \quad (10)$$

is adapted from Sinreich et al. (2013) (i.e.

$$f_c = \frac{c_{retrieved}}{c_{real}} = \frac{\frac{dSCD_{NO_2}}{L_{eq,O_4}}}{\frac{VCD_{NO_2}}{PBLh}}, \quad (4)$$

),

is the derived f_{corr} as function of O_4 DAMF also the same as that of Sinreich et al. (2013) (i.e.

$$f_c = \frac{\mathrm{dAMF}_{NO_2} \cdot \mathrm{PBLh} \cdot c_{O_{4_{instr}}}}{\mathrm{dAMF}_{O_4} \cdot \mathrm{VCD}_{O_4}}, \quad (5)$$

),

or are there any modifications for this study? Anyhow, a complete equation needs to be presented in the paper so that the readers could follow the discussions more easily.

It is stated in Page 8139 and Line 1 that "c_{real} is the real surface-near trace gases concentration which was used as input in the RTM". It might not be appropriate to use "real" here since "c_{real}" is merely a prescribed model parameter instead of the measured trace gas concentration in the real atmosphere. For the first glance of Eq. (10), f_{corr} seemed to be a correction factor derived from the measurement data (c_{real}) along with the corresponding model results ($c_{retrieved}$). After reading the text and also corresponding part of Sinreich et al. (2013) more carefully, I realized that "c_{real}" in both studies actually refers to C_{model_real} (more exactly C_{model_input}).

Trace gases are assumed to be homogeneous distributed in the box layers with altitudes of 0.1, 1 and 2 km in this study, which are the same as PBL heights? Do $c_{retrieved}$ and C_{model_real} stand for the concentrations averaged over the PBL, or box layer, or the sensitive altitude range (h) at an elevation angle (1° for this study)? But it seems that the measured O_4 DAMF that was used to calculate f_{corr} should correspond to a sensitive altitude of h instead of PBL in the study. Will the uncertainties of f_{corr} become smaller at the 1° elevation angle than other larger elevation angles?

Technical issues

P8130, L14: Using only one elevation angle?

P8132, L15 and P8133, L14: Full name for dSCD should be given when it appears first in the text.

P8133, L22: Full name for GM-DOAS is not given before, except in the abstract.

P8136, L22: Is it a typo for "0.817", since it may not be a representative value for single scattering albedo in the free troposphere.

P8144, L18-19: As shown in Figure 15, there should be higher AOD and shorter L_{eff} on 18 and 21 May.

P8145, L5 and L7: Should be Fig.17, Fig.17a and Fig.17b?

P8145, L19: In contrast?

P8153, L1: Supplement should be referred to instead of Table 2.

Supplement: It would be helpful to add some words like “Correction factors as function of the O_4 dAMF” in the title of the table.

Reference

Sinreich, R., Merten, A., Molina, L., and Volkamer, R.: Parameterizing radiative transfer to convert MAX-DOAS dSCDs into near-surface box-averaged mixing ratios, Atmos. Meas. Tech., 6, 1521-1532, 10.5194/amt-6-1521-2013, 2013.