

## ***Interactive comment on “Mobile MAX-DOAS observations of tropospheric trace gases” by T. Wagner et al.***

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General comments:

“Mobile MAX-DOAS observations of tropospheric trace gases” by T. Wagner et al. describes an algorithm that can be used to retrieve vertical column densities (VCD) of trace gases from mobile platforms. The algorithm is applied to MAX-DOAS measurements taken from a car during a trip from Brussels to Heidelberg. The paper fits well into the scope of ACP and reads well.

The authors describe a new method for the analysis of MAX-DOAS observations from mobile platforms. Instead of taking the zenith viewing measurements at each scanning sequence as a reference (which is often done for ground based MAX-DOAS measurements to obtain VCDs), a single zenith viewing measurement is used for all data during

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the measurement period. Then they use a statistical method to determine the difference between the slant column density (SCD) in the reference spectrum and the SCD in the stratosphere, DSCDoffset (section 3, figure 3). The latter is needed to obtain absolute VCDs from the data.

While the concept of taking a single reference spectrum and determining its SCD by statistical means is not necessarily new (see e.g. Herman et al., J. Geophys. Res., 114, D13307, doi:10.1029/2009JD011848, 2009), the authors can claim to be the first ones having applied this concept to car MAX-DOAS measurements.

The error estimation for DSCDoffset uses the basic assumption from page 2862, line 9: “The deviations of DSCDoffset from the true value occur randomly, because the probabilities that the trace gas concentration was either higher or lower during the first measurement are the same.” The data around the power plant show that this is not always true (figure 3). The authors explain that around the power plant the geometrical approximation for the air mass factor (AMF) is not valid and have therefore removed those points before fitting the polynomial. The region around the power plant produced many more negative outliers than positive ones (figure 3). So does this mean that whenever the geometrical AMF is not applicable, the data tend to be biased low? What about all other situations (i.e. not around the power plant)? Do (even small) inaccuracies in the geometrical AMF systematically produce more negative biases than positive ones and therefore shift the whole fitted polynomial to lower values and consequently lead to an underestimation of the VCDs?

The authors should comment on the questions of the previous paragraph.

Specific comments:

- Page 2854, line 16: Clarify the sentence “The only requirement. . .easily fulfilled).” What exactly does it mean “. . .scanning sequences within continuous measurement period”?

- Page 2855, line 24: What is the “simplest case”?

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- Page 2855, line 25 and page 2859, line 10: There is no need for the personal communication reference since peer-reviewed references are also given.
- Page 2856, lines 2 to 5: The two sentences give the impression that the only reason vertical profiles can not be retrieved from car MAX-DOAS observations is that the view at low elevation angles is often blocked, and for airborne observations vertical profiles could be retrieved. This is in contradiction to section 2.4 (and figure 1, top). I suggest the authors add that vertical profiles from mobile platforms can in general only be retrieved if all viewing angles are measured at the same time, except the speed of the moving platform is small compared to the spatial variability of the trace gas field, which might be the case for measurements from ships.
- Equation 3: Shouldn't " $=DSCDtrop(\alpha)$ " be removed from equation 3? It does not seem to be correct at this stage. It 'becomes' correct later when  $DSCDmeas(90)$  is used as reference (equation 5).
- Page 2860, lines 17-24: what exactly do you mean with "(also the actual integration time to the . . . is reduced)"?
- Page 2865, line 2: the duration of an individual measurement is said to be 20-25sec; are these several cycles over a certain integration time? What are typical integration times?
- Page 2866, lines 16 t 20: Explain what errors are meant in the sentences "From the scatter we estimate. . .compared to other error sources."

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