

Interactive comment on “Sensitivity studies for a space-based methane lidar mission” by C. Kiemle et al.

C. Kiemle et al.

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Dear AMT Editor,

Please find hereafter our answers to each of the comments by the second referee which we found very valuable. We intend to submit a revised version of our manuscript by 15.9.11.

Best regards, Christoph Kiemle, 7.9.2011, on behalf of all co-authors.

The second referee suggests including a discussion on the following two issues:

1. The precision in the measurement of surface range. We agree that, since the

C1511

methane density is largest near the ground, uncertainties in the path length determination have an impact. Ehret et al. (2008) found that for CO₂, a path length uncertainty of 2 m leads to a column measurement error of $\sim 0.02\%$. For methane this error amounts to $\sim 0.03\%$ according to our calculation. The calculation takes into account the limited effective height of the weighting function mentioned by the referee. Like Ehret et al. (2008) we assume that a ranging precision of 2 m can be achieved with a detection bandwidth of 3 MHz. However, details on this, as well as the other related issues listed by the referee, including terrain height changes in forests that lead to a stretching of the return pulses, are beyond the scope of this paper and belong more to detailed technical design and retrieval algorithm optimisations.

2. Amediek et al. (2009) used airborne lidar measurements to assess the error by partial overlap of the on- and offline footprints in the context of varying surface reflectance. Full overlap is not only hindered by non-simultaneous measurements, as mentioned by the referee, but also by variations in platform pointing or laser beam geometry. After up-scaling to a space-based measurement with a footprint of 100 m diameter, an on- and offline footprint shift of 10 m, and 350 measurements over a 50-km track length, they obtained an average error of $\sim 0.06\%$ on the CO₂ column. Adapted to our measurement geometry, as displayed in Figure 1, the error on the methane column amounts to $\sim 0.15\%$. It is small, but admittedly not negligible.

We will include the suggested discussion of these two issues in section 2.

The second referee has the following minor comments:

1. Eq. (1): define P. We will write in the sentence before Eq. (1): “... the optical power P incident on the detector ...”
2. Will be modified as suggested.
3. We agree and will write instead: “In the short-wave infrared where eye safety for a zenith-viewing observer is less critical, methane lines with appropriate strength are

C1512

essentially found in two water vapour transmission windows around 1.6 and 2.3 μm .”

4. “Single-measurement” here means “individual measurement”, in the same sense as in line 5 of p. 3559. We will write “. . .the relative single-measurement uncertainty on. . .” instead to avoid confusion.

5. The dry-air volume mixing ratio of water vapour is the ratio of the densities of water vapour and dry air. It is necessary here and we will include an explanation.

6. We bought the detector from the company Laser Components, the type is IAG200T6. We will include this information in Table 2.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 3545, 2011.