General Comments

Jianping Mao et al. report on airborne CO_2 measurements using an integrated path differential absorption (IPDA) lidar with focus on cloud tops as the backscatter targets. Since certain cloud coverage is present at most parts of the world, airborne and especially future spaceborne IPDA lidars will be faced with these conditions frequently. The presented specific analysis of IPDA lidar measurements to cloud tops gives valuable information about the performance of the IPDA technique for these situations. The authors show measurement results for different common cloud types and its characteristics. Additionally, the possibility to retrieve partial column mixing ratios – especially for the boundary layer – for cases, at which measurements to cloud tops and the ground are made alternatingly, is shown.

The paper is well written and gives a detailed overview of IPDA measurements to cloud tops. The structure is clear and all information is presented comprehensibly (except for some minor details mentioned below). I recommend the publication in AMT.

Specific Comments

Section 2, p. 2, l. 24/25: "This is considerably higher than that of GOSAT…"

I guess, it is meant: "The laser's spectral line-width is considerably narrower than the spectral resolution of GOSAT…". Please reword accordingly.

p. 2, l. 35: "The range backscatter profiles are recorded for all laser wavelengths at a 10 Hz rate."

Why 10 Hz? Does it mean that the raw pulses are accumulated down to a 10 Hz rate to get a better SNR for the range determination? Please describe this fact clearer.

p. 3, l. 23: "The standard deviation increased to about 1 m after measurements are averaged over 5 seconds"

Do you mean the standard deviation of the original 10-Hz range measurements inside averaging intervals of several seconds? This is indicated by the statements in lines 15-20 and seems to be comprehensible. In contrast, in the following it sounds like, if the standard deviations for series of averaged range measurements (inside a certain flight section) increase with longer averaging intervals. This doesn't seem to be logical. If an averaging is done on the scale of the variations or longer, a smoothing should occur. Maybe this is expressed mistakably or there is some information missing about calculation details that can substantiate the statements. See also p. 3, l. 29-35.

Additionally, the impact and the conclusions of these findings should be explained more in detail.

Figures 3 - 5.

The same as above.

Figure 7, right panel:

Is this a single pulse measurement or averaged?

Section 3.1

How are clouds distinguished from ground (except by using radar data in some cases), e.g. in case of pronounced topography of a flight section, as shown in Figure 10?

Section 4.1, p. 6, l. 18

Was it possible to fly the spiral down to the ground? If not, how were the missing data for the complete column obtained?

Section 4.1, p. 6, l. 19/20

Are any special calculations necessary (e.g. weighting) to get the AVOCET XCO_2 data in such a manner that they are directly comparable to the lidar XCO_2 data? Or do both represent the same column averaged mixing ratios inherently?

Section 4.2, lines 39ff, and Figure 12

The vertical profiles of the model CO_2 are mentioned and shown in the Figure, but the resulting model XCO_2 (like above the AVOCET XCO_2) is not given here.

Section 5, p. 9, l. 18

Please repeat shortly the reason of the degradation and please add which quantity (instead of “retrieval”) is degraded by the given factor.

Technical Corrections

p. 2, l. 24

15 MHz correspond to 0.0005 cm^{-1}.

p. 4, l. 31:

Should be “Table 1”.