

amt-2018-376 Submitted on 23 Oct 2018

Development of a balloon-borne instrument for CO₂ vertical profile observations in the troposphere

Reply to the comments by Editor

Comment by Editor

Thank you for having responded to all open questions. There is still one minor request linked to the functioning of the optical analyzer.

As you state correctly in the corrected version of your manuscript,

"Although the NDIR analyzer potentially exhibits non-linear absorption due to the saturation of strong absorption lines, the NDIR analyzer is known to have a good linearity within a certain concentration range [Galais et al. 1985]. In our analyses of the balloon data, eq. (1) was used only for the interpolation between the low and high mole fractions of the in-flight calibration gases to obtain the ambient CO₂ mole fractions."

the linearity of the instrument is restricted to a certain range. I have modelled the conditions of 0 - 500 ppm CO₂ in a dry O₂/N₂ mixture in a 12 cm cell at 1 atm and 296 K (see top of attached figure that can be downloaded as comments-to-author file) using actual spectroscopic data from the HITRAN data base. The bottom figure shows the integrated absorption signal when a rectangular filter function is used (such that 400 ppm gives about 3 % of absorption). It is apparent that the peak absorbance is about 0.7 at 400 ppm (thus it is not small) and that the broadband signal does not follow the equation in line 177 of your revised manuscript.

Please revise this paragraph so that theory and your application become consistent. I propose to clearly state that eq 1 and 2 hold for monochromatic light only and that eq 2 only holds for small absorptions. Then you can continue with the above phrase. I also strongly suggest removing the word potentially in your above phrase.

(reply)

I appreciate the editor for the valuable comments. We have removed the word "potentially" and have added the description on the limitations of eq. 1 and 2 according to the comments, as follows.

(lines 180-184)

The eq. (1) and (2) hold for monochromatic light only and that eq. (2) only holds for

small absorptions. Although the NDIR analyzer exhibits non-linear absorption due to the saturation of strong absorption lines, the NDIR analyzer is known to have a good linearity within a certain concentration range (Galais et al. 1985).