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Reply on RC2

Marcel Snels et al.

Author comment on "A simulation chamber for absorption spectroscopy in planetary atmospheres" by Marcel Snels et al., Atmos. Meas. Tech. Discuss.,
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We thank both referee for his comments and suggestions. The main point regards a meaningful comparison with previous studies and a discussion of the improvement with respect to the state of the art.

An example of new measurements with PASSxS has been discussed in detail and compared with previous measurements at temperatures below and above room temperature. Since one of the principal goals of PASSxS is the study of collision induced spectra at a range of temperatures, we've chosen to remeasure several collision induced bands of carbon dioxide at different temperatures at a pressure of about 16 bar. At this density carbon dioxide starts to liquify around 239 K, which puts a limit to the lowest temperature that could be obtained without changing the gas density. It is also well known that the CIA absorption coefficients of carbon dioxide tend to decrease with higher temperatures, which renders the weaker bands difficult to observe for high temperatures.

The significance of the data extracted from these spectra (band integrated CIA absorption cross sections) depends strongly on the signal to noise ratio, which has been calculated here for the absorbance observed in all studies (the SNR of the absorption cross sections equals the SNR of the absorbance). We assume that the detector noise (which is mitigated by averaging the spectra) and baseline errors are similar for all studies, since no specific information is available in [Baranov2003]. The results have been displayed in a new Table 3. The result is that PASSxS produces more accurate parameters for both temperatures.

Also the temperature stability has been discussed in more detail. First we consider passive cooling and heating, when the cell is free to drift towards the ambient temperature, and we find a drift of 3-6 K/h. In this regime the temperature homogeneity, as inferred from the difference of the temperature measured by the two thermocouples in the gas at different positions (long and short) is always better than ± 2.5 K.

When an active temperature stabilization is applied, by PID regulation of the heaters, the temperature homogeneity is better, about ± 0.7 K when the cell temperature is above room temperature and about ± 1.5 K when it is below.

For what concerns the accuracy of the absorbance measurements we have discussed the possible error sources in more detail. The main error in the determination of the absorbance is the baseline error. Ideally the absorbance should be zero in absence of absorption, but in practice the baseline after recording and processing an actual

absorption spectrum and a background spectrum is not exactly zero for the full spectral range, but might have a small offset or a wavenumber dependent offset, typically this is less than 0.01. Often a baseline correction is applied, adding an offset to obtain zero absorption. After the baseline correction, a residual baseline error might be in the order of 0.0001 to 0.001. The second error source in the absorbance is due to the detector noise, thermal noise and ADC (analog-to-digital converter) noise. Part of this noise can be mitigated by averaging over many FTS scans. We have observed noise levels of the order of 10^{-5} with 256 averages.

Fig 10 has been eliminated and a new figure has been inserted and extensively discussed (see also above)