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Interactive comment on "The impact of SCIAMACHY near-infrared instrument calibration on CH_4 and CO total columns" *by* A. M. S. Gloudemans et al.

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The authors would like to thank the referee for his/her constructive comments on our manuscript. The referees' specific comments are addressed below in order of appearance.

Answers to specific comments:

Abstract: The most important reason why the impact on the CH_4 total columns is

more pronounced is the smaller variability of CH_4 compared to CO and corresponding higher requirements on the retrieved total columns. A clarification of this statement has been added in the abstract.

The authors do not say that "the effect of a dead/bad pixel is more a random effect", but they say that " the effect of the dead/bad pixels is a more random effect", meaning that the overall effect of all dead/bad pixels together on the retrieved total columns is unpredictable. The referee is correct that for one bad/dead pixel the effect can be really random, but also systematic. Nevertheless, one cannot predict beforehand how a dead pixel is going to behave and in that sense the total effect of all dead/bad pixels is of a more random nature than the other two effects discussed in the paper. After rereading the text, the authors think that the word "unpredictable" may be less confusing and some clarifications as to what is meant are added in the abstract too.

Introduction: Model calculations show that these values are needed to measure the variability in CH_4 and CO. As far as the authors know, no official reference (in a refereed journal) exists for this statement. This sentence has been modified to clarify this and some references to calculations of these values have been added. These values refer to the precision, but ultimately the aim is to obtain an accuracy of the same order.

Section 2 Instrument calibration: This is no speculation: the broadening of the wings is clearly seen in the analysis of the SLS spectra. This has been added to the manuscript. However, these measurements cannot be used to correct the nadir spectra, since the slit is only partially illuminated during the SLS measurements, while the whole slit is illuminated during the nadir measurements. Thus, these measurements are simply not suitable for an "accurate" correction, which is needed in order to determine accurately retrieved total columns. The authors do not say that this broad-

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ening is difficult to measure, they write:" this is difficult to correct for..... and cannot be determined independently". This does not mean that the broadening is not present, only that it is difficult to obtain an accurate correction for this broadening.

Section 3 Retrieval algorithm: Middle of page 5: A few sentences have been added to stress the possible problems with this approach.

Bottom of page 5: A short quantitative statement is added in the manuscript.

Section 4 Retrieval results: Beginning of Section 4.1 CH_4: The measurement noise is determined for each measurement from in-flight data. It includes the following components: electronic read-out noise, detector Johnson noise, detector dark current shot noise, thermal background shot noise, and scientific signal shot noise. The first two components are derived from ground calibrations, the other from the measurement data.

Middle of Section 4.2 CO: This has been changed.

End of Section 4.2 CO: The standard deviation is larger than the instrument-noise related precision. Part of this may be due to retrieval errors and part of this may be real: because of the larger sensitivity of SCIAMACHY to the boundary layer, a larger variability in the retrieved CO total columns from individual measurements is expected. A more detailed analysis will help to distinguish between these two. This has been added to the manuscript.

Beginning of Section 5.1: Care has to be taken when deriving conclusions from the fit residuum, since a larger fit residuum does not necessarily point to the broadening of the slit function: subtracting the wrong dark signal will also lead to a larger fit residuum and a dead pixel that is not recognized by the dead/bad pixel mask may also result in a larger fit residuum. Vice versa, the broadening of the slit function's wings does not necessarily lead to an increase in the fit residuum or e.g. the reduced chi-square of the fit. The IMLM retrieval algorithm performs a fit to the actual measured detector

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spectrum. The growing ice layer causes a decrease in the measured signal resulting in a lower signal-to-noise ratio, since the total noise consists of several components, not all of which are affected by the ice layer. Thus, in fact the reduced chi-square may even be smaller for a thicker ice layer and the same is true for the root-mean-square of the fit residuum the referee is mentioning. In our retrieval method, the fit residuum or reduced chi-square can be used to determine the best fit for one particular measurement, but comparing the fit residuum of one measurement to that of another measurement with a different signal level is dangerous and not meaningful. In addition, SCIAMACHY's channel 8 contains many lines of H_2O, CH_4, and CO, mostly overlapping. Therefore, individual line wings can hardly be distinguished, which is also one of the reasons why it is so difficult to correct for the broadening of the slit function's wings. In our method the fit residuum only gives information on the total fit of the spectrum and not on the fit of the individual species.

Direct evidence for the broadening of the slit function's wings comes from the SLS measurements. It is noted that these measurements clearly show a broadening of the wings as the ice layer grows thicker. One of the other referees, Christian Frankenberg, in fact had a similar comment on the broadening of the slit function's wings and the manuscript is modified to clarify some of the aspects of the slit function's broadening.

Comment on using the Sahara in the slit function correction: It should be stressed that the geographical region used for determining the slit function correction is smaller than that used for showing the effect of the broadening of the slit function's wings. Nonetheless, the referee is correct in saying that this does not guarantee that this methods works outside the Sahara as well. However, Fig. 3 already shows that this method works on a global scale. Selecting Australia instead of the Sahara shows the same effect as seen in Fig. 7 and does not change the values listed in Table 1. Since more data over the Sahara is available than most other regions in the world, the Sahara case gives better statistics than Australia. Therefore, the authors would like to leave Fig. 7 as it is, but they have added a note in the text on the additional calculations for

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Australia showing the same effect.

Comment on the size of the dark signal correction: It is not completely clear to the authors which dark signal correction is meant here: the correction for the slit function's wings or the variation of the dark signal within an orbit. For clarity both numbers are given in the revised manuscript.

Caption of Fig. 8: The words 'too high' have been replaced by 'higher' which is indeed more appropiate.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 1733, 2005.