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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 constructive comments on our manuscript. The referees' specific comments are addressed below in order of appearance.

Answers to specific comments:

Abstract: An opening sentence explaining the SCIAMACHY instrument very briefly

has been added.

Page 1737, line 11: This statement refers to the calculations done by G. Lichtenberg: see the ACPD paper Lichtenberg et al. (2005). In fact, the calculation of an ice layer thickness is relatively straight-forward once one has the absorption coefficient. The formula used for these calculations can be found in the document: G. Lichtenberg: Some results on ice and IR transmission in SCIA, Tech. Report SRON-EOS/RP/03-003, 2003, http://www.sron.nl/www/code/eos/sciamachy/calibration/docs/transmission_0303.pdf. A reference to Lichtenberg et al. 2005, ACPD has been added to the manuscript.

Page 1738, line 13: Indeed the daily dark measurements are used in the retrievals. The deviation from the measured dark current is the absolute difference between the actual dark current at a particular point in the SCIAMACHY orbit for one day and the measured dark current for the same day. Both of these are influenced by the ice layer so that the absolute difference also depends on the thickness of the ice layer. On the other hand, the relative difference is in principle not dependent on the ice layer, since then the ice layer dependency is divided out: (actual - measured)/measured dark signal.

Page 1739, line 22: After looking at many SLS spectra measured for different thicknesses of the ice layer it was concluded that the slit function for a situation with a thick ice layer can be approximated by a slit function for an ice-free measurement plus an additional background signal. This background signal is assumed not to be wavelength dependent, which is correct as long as only a small spectral range is used for the retrieval. This background signal does indeed vary from measurement to measurement. This has been accounted for in the retrieval code, so that no albedo dependency is introduced. The slit function used is a measured one corresponding to an (almost) ice-free situation and this shape is kept constant in all retrievals. The change in the wings is accounted for by the baseline approach used in the retrievals, which is determined

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on a daily basis by comparing to the Sahara CH4 total columns. The correction for slit function's wings shows a good correlation with the signal in the wings of the SLS spectra, which shows that it is indeed a reasonable approximation. The authors doubt that using a smooth time dependence of the background signal could help to discriminate between changes in the background signal and actual changes in methane over the Sahara, since the decrease in the signal due to the growing ice layer does not behave as a polynomial of some other smooth function of time, as can be seen in Fig. 2. By using a polynomial fit one can actually introduce errors instead of making them smaller. Note that because of possible variations in the CH4 total column, a region of the Sahara has been selected where the CH4 total column variation in time is very small, i.e. smaller than the sources and sinks of methane one wants to study. Moreover, the Sahara has been selected because of the absence of strong sources and sinks. This is already stated in manuscript.

The authors have attempted to clarify the issues raised by the referee in the revised manuscript (see Sect. 2 at the bottom of page 1737, and Sect 3, page 1739). For the more detailed information on the slit function the referee is referred to a SCIAMACHY technote on the slit function broadening which is currently in preparation.

Page 1740, line 5: A reference to a document describing these patched level 1 files has been added.

Page 1740, line 24: These references have been added to the manuscript.

Page 1742, line 16: The word "polluted" has been removed.

Page 1742, line 24: The word "cloud-free" has been added to clarify the point made by the referee.

Page 1748, line 9-12: Assuming that "the applied additional background signal" refers to the correction for the broadening of the slit function's wings, the answer is already given under the comment "Page 1739, line 22": the correction applied depends on the

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total signal.

Page 1749, line 17-20: The manuscript states that a pixel that does not sample (part of) an absorption line, is not expected to have an effect on the retrieved total columns, whereas a pixel that lies at the centre of an absorption line is much more likely to affect the retrievals. Thus, not only a dead pixel at the center of a CO absorption line affects the CO retrievals, but also a dead pixel at the center of a CH_4 line or an absorption line of any other molecule can affect the CO retrievals. In that case it is an indirect effect: since the CH_4 lines are not fitted well because of the dead pixel the retrievals try to compensate by fitting a higher or lower CO total column. For clarity the this sentence has been modified to explain that there is both a direct and an indirect effect of a dead pixel as explained above.

word 'any' is added to the manuscript to indicate that a dead pixel at the center of any molecular absorption line can affect the CO retrievals.

Page 1751, line 24: The referee is correct when it concerns pixels with a high noise level. However, the so-called Random Telegraph Signal (RTS) pixels (see page 1750 lines 13-21) can have a low noise level, but still be unreliable. In those cases the problem is simply that a wrong dark signal is subtracted from the measurement. This can still give good fits to the measured spectra, but result in retrieved total columns that are too high or too low. In those cases a dead/bad pixel mask based on fit residuals only does not work. The RTS pixels are now named in the manuscript as an example of a case where a dead/bad pixel mask based on fit residuals only does not work.

Section "Effect on retrieval windows": The effect of the overlapping H_2O lines has been added to the text. Although in general there is a good correlation between the retrieved H_2O total columns from different spectral windows, there are cases with substantial differences too.

Second point: there is no specific scientific reason why we didn't investigate a window without strong H_2O lines for the methane retrievals. The only reason is that we wanted

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to investigate the effect of different retrieval windows on both the CO and CH_4 total columns and since each window requires the determination of a new correction for the broadening of the slit function's wings, which is quite time-consuming, only windows containing both CO and CH_4 have been investigated for efficiency. However, it is indeed instructive to perform such retrievals and the authors will look into this issue for a future paper.

Discussions (page 1754, line 27): The authors want to point out that the effect of the dead/bad pixels is not "predictable". Looking at the effect of the variation of the dark signal over the orbit and the effect of the broadening of the slit function's wings one can predict the general behaviour of this effect, e.g. the CH_4 and CO total columns will decrease in time when the ice layer becomes thicker and the CH_4 total columns will be overestimated if one does not correct for the variation of the dark signal over the orbit. But, one cannot predict what effect one omitted dead/bad pixel has on the retrieved CH_4 and CO total columns. So in that sense it is a more random effect, although the referee is correct to note that one dead pixel has a similar effect for all retrievals where this particular pixel has not been masked out. The corresponding text in themanuscript has been modified removing the word 'random'.

Conclusions: Looking at fit residuals is indeed not sufficient to detect ALL dead pixels: it will however detect the majority of the dead pixels.

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