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Interactive comment on “First ground-based FTIR-observations of methane in the tropics” by A. K. Petersen et al.

Anonymous Referee #3

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The paper discusses measurements of methane total column amounts from ground-based FTIR measurements in the near-infrared at the station of Paramaribo in Suriname. The ground-based data are compared with SCIAMACHY data from 2 algorithms, namely WFM-DOAS and IMAP-DOAS, with TM5-4DVAR model data, and with data from local surface samplings. In the present version of TM5, surface data from the NOAA ESRL air sampling network, at marine and continental background stations, have been assimilated.

General Comments

The purpose of the paper is to present the first validation of SCIAMACHY retrievals in the tropics. However, the discussion of the validation results is done in a very qualitative way. The only validation results are the figures 1 and 2. One can see a 'reason-

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able' agreement between the FTIR data and the SCIAMACHY data, during the short campaign periods where FTIR data are available. One cannot say anything about the seasonal variation, as confirmed in the paper, because there are no FTIR data covering all seasons. Moreover, part of the years 2004 and 2005 have to be discarded from the validation because the FTIR data were affected by biomass burning pollution. This makes the finally available datasets for validation very limited. This is a serious drawback of this validation work. Of course in the tropics, FTIR measurements are very difficult, because they need dry weather conditions which are not available all-year-round. Still, the paper requires more quantitative and more in-depth discussion of the validation results, taking into account also the large scatter on the SCIAMACHY data. At present, the paper does not really provide a clear answer to what one can really conclude from this validation exercise. Also the SCIAMACHY data from the 2 algorithms look very different in Fig. 1. Apart from saying why they are so different (pg. 2309), this is completely neglected in the discussion of the validation results.

Another point to be better explained in the paper is the validation approach. In Fig. 1, one compares XVMR values from SCIAMACHY and ground-based FTIR that are derived in 2 different ways: for the FTIR according to Eq. 2, for SCIA according to Eq. 3. Is it not feasible to compare SCIA with ground-based FTIR XVMR values that are derived identically according to Eq. (3) ? As far as I know, the FTIR measures CO₂ simultaneously with CH₄ ? And as far as I understand, the data in Fig. 2 are derived using the simultaneously measured CO₂ column? And what is the exact usefulness of Fig. 2 in the whole validation approach?

Another - to my opinion - weak point of the paper is the statement that the data confirm the recent findings by Rigby et al and Duglokencky et al. concerning the enhanced methane levels in 2007 compared to earlier years. The figures shown in the paper are not at all convincing me that this enhancement was also seen in the FTIR ground-based data or in the model or in situ data.

Specific comments

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* Title: The title is not correct as it is. With 'the tropics' one usually refers to the latitude region included between the Tropic of Cancer and the Tropic of Capricorn, ie between 23.5° N and S. Senten et al. (ACP, Vol. 8, 3483-3508, 2008) already reported CH₄ measurements at 21°S (hence the tropics) from ground-based FTIR observations. The Senten et al. measurements were performed in the mid infrared, whereas the actual work reports measurements in the near-infrared. As far as I know- the authors are right that these are the first reported ground-based measurements of CH₄ in the tropics in the near-infrared spectral region. Or the authors wanted to point out that they are measuring in the equatorial region ? In any case, the title should be corrected.

* Introduction, lines 20-24: 'The first space-borne measurements for CH₄....'. SCIAMACHY is not the first satellite experiment to provide data for methane. There are many other satellite sensors before SCIAMACHY that have provided CH₄ profiles in the upper troposphere - stratosphere, like ATMOS, HALOE, ACE-FTS, ... SCIAMACHY is probably the first one that provides good data for total column CH₄. Although one should not forget that IMG has provided limited data sets for total column CH₄ -> see the following paper: 'Latitudinal distribution of methane as observed by IMG sensor aboard ADEOS satellite' (Proceedings Paper) Author(s): Ryoichi Imasu; Toshihiro Ogawa; Haruhisa Shimoda in SPIE Proceedings Vol. 3501, Optical Remote Sensing of the Atmosphere and Clouds, Jinxue Wang; Beiying Wu; Toshihiro Ogawa; Zheng-hua Guan, Editors, pp.84-91 Date: 18 August 1998.

So the authors should formulate their statement more correctly.

* Section 2 - pg. 2306, line 2: 'with respect of instrumental influences' -> correct to 'taking into account instrumental influences' - pg. 2306, line 29: 'a too restricted retrieval algorithm due to profile retrieval' : I think the authors wanted to say 'due to profile scaling only retrievals'. In any way, as stated actually, this is very misleading. - pg. 2306, line 26: it is said that the CH₄ total column results strongly depend on the a priori choice. It is known that this is also the case (even if it may be less) when you make a real SFIT2 profile retrieval. This sensitivity is not discussed in the paper. Moreover, the

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paper does not provide any information about the uncertainties (error budget) associated with the CH₄ total column data that are presented and used for the validation of SCIAMACHY. The authors should provide this information and discuss how it is taken into account in the validation exercise. - pg. 2307, line 5: 'as commonly applied for the retrievals of trace gas profiles in the MIR': what exactly out of the previous characteristics of your SFIT2 approach are you comparing to the common approach in the MIR? The sentence is not clear. - pg. 2307, lines 10 to 15: it is not clear whether the a priori choices listed here are the same ones as the ones used initially in the profile scaling approach ? If so, then all this information about the a priori choices should be moved forward in the text. If not, then it should be made clear how the a priori was changed. - pg. 2307, Equation (2) In this equation, one needs the total column of H₂O: does it come from the retrieval or from NCEP? What is its uncertainty? So how does this uncertainty affect the uncertainty on XVMR(CH₄)? - pg. 2308, line 5: How to interpret the sentence 'The potential errors in the FTIR observationscompared to the diurnal variations' ? This is not clear... - pg. 2310, lines 6-7: 'we expect 0.3 to 1.7 x 10¹⁷ molec/cm²': I don't see where the value of 1.7x10¹⁷ comes from? - pg. 2312, lines 4-5: 'indicating the strong influence of local and regional sources'. Can the authors give more information about these sources ? Do the authors have some 'proof' of the impact of these sources on the data ? - pg. 2313, line 4: 'which we account to biomass burning' should be 'which we assign to biomass burning'.

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