

## ***Interactive comment on “Evaluation of single-footprint AIRS CH<sub>4</sub> Profile Retrieval Uncertainties Using Aircraft Profile Measurements” by Susan S. Kulawik et al.***

### **Anonymous Referee #2**

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General comment: The paper describes the validation of single footprint AIRS methane measurements by aircraft data from the HIPPO and ATom campaigns and NOAA aircraft measurements. The validation formalism is set up first, then the assessable components of the AIRS error budget as measurement error, validation error and bias are introduced and discussed. The paper closes with an assessment of the non-reducible error of AIRS methane averages.

Over all the paper is sound, the formalism is well introduced, and the error components are convincingly derived. I think the paper can be published after minor revisions, which are, however, numerous. I will list here the most important ones only. For the others I

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attach the annotated manuscript.

Specific comments:

(1) During first reading I got confused at several instances because an error was introduced by number, while the path towards derivation of this error was only explained in the next para or section. I always thought I have missed a part of the manuscript but found out with re-reading that the explanation follows on the number. It would be easier (at least for readers like me) to first provide the explanation and then the number.

(2) The authors use very often the term "partial column". They need to introduce how the partial methane column over the pressure range the aircraft had measured has been calculated, both for the aircraft and AIRS data (what shape of the methane profile? where do pressure and temperature profiles come from?); further, the figures usually show volume mixing ratios (in ppb) instead of partial columns. This might sound picky, but I think this accurateness in wording should be kept.

(3) I was a bit surprised that the two models that were used to assess the so-called "validation error" (i.e. the unknown stratospheric part of the profile) provided largely different results (4.4 vs. 15.7 ppb). I think the authors should elaborate a little more on the reasons for this large difference. This is particularly important because the averaging kernels in Fig. 2 demonstrates that the stratospheric information is large mapped into the troposphere below 300 hPa, i.e. the AIRS signal obviously depends a lot on the assumptions about the stratosphere. Is it possible that the use of other models leads to even larger estimates of the validation error?

(4) A side remark without relevance to the revision of this paper: the SPARC TUNER activity has worked on recommendations about error reporting. A paper on this topic has just been accepted by AMT. It would be nice to look into that paper (amt-2019-350) and possibly following these recommendations in future.

Please also note the supplement to this comment:

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<https://www.atmos-meas-tech-discuss.net/amt-2020-145/amt-2020-145-RC2-supplement.pdf>

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-145, 2020.