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Atmospheric Measurement Techniques Discussions

Interactive comment on "The effect of horizontal gradients and spatial measurement resolution on the retrieval of global vertical NO_2 distributions from SCIAMACHY measurements in limb only mode" *by* J. Puķīte et al.

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Here are the comments/remarks that came to my mind while reading this paper.

First, I should say that the overall quality of this article is excellent : it is well structured, sentences and explanations are precise, figures helpful and one can feel that large efforts and carefull analysis have been deployed to reach these very interesting and useful results. I hope the following comments are not too naive and will help to make some points more clear. I list them below following the structure of the paper.

- General comment : bias (between 1D and 2D, 1D and true, 2D and true) is widely

used for adressing the accuracy of the technique, but it is almost never mentioned what is the impact of the random error of the retrievals. If this component is large (larger than the difference between 1D and 2D retrievals), what would be the consequence on the conclusions of this study? (I absolutely don't want to say that tomography is not improving, it is definitely! But I would like to balance the results regarding the random error of these retrievals) Especially for the Fig 4 and 5 for which you say in the 3rd paragraph of the page 9 that "this retrieval error is on the order of the correction due to the gradient effect [...]. [...] the retrieval error [...] and the difference between the 1D and 2D retrieval are compared in Figs 4 and 5 [...]." But I don't see any "retrieval error" in these figures...

- p.10, 2nd paragraph : in averaging the orbits, you explain the smaller difference between 1D and 2D by the "improved statistics"... but I don't understand this argument...

- In the same section, you say that there are large differences of gradients from an orbit to another. Would it be possible/useful to use the data from the adjacent orbit and use the gradient information to improve the results in a 3D model?

- Last paragraph of section 4.1 : you compare the results of the fig.12 and the fig.9 despite the fact that they don't show exactly the same thing : fig.9 shows the difference between 1D and 2D retrievals of real measurements fig.12 shows the difference between 1D and true values (of simulated measurements) Moreover, in the fig.12, I don't understand very well how you can have such a strong and steep correlation between for instance a gradient at 20km and the bias at 30km...? (even with small gradients)

- In the 2nd paragraph of p.17, you say (and it seems convincing regarding the results of the fig.13) that there must be a better latitudinal sampling than 3.3°. But in section 4.1.3 at the end of p.18, you say that it can't be improved... To me it looks like a small contradiction, but still, there must be a way to get rid of the gradient effect on the 2D retrievals...

- Section 4.2.1 : It seems that you can't retrieve correctly when the gradient isn't smooth

enough... Is this a consequence of your 100% a priori covariance matrix which is constraining too large variations? And by the way, are there any off-diagonal elements in this matrix?... The retrieval procedure is not that detailed. (but I know that it was not the point of this paper)

- Small question : Would a finer sampling grid allowing for correlation between 3 limb scans at least help improving bias errors?

Typo :

- caption of the Fig 8 : double "the".

- p.13 2nd paragraph : "Relative values for the analyzed orbits are indicated in the left panel of fig 10". I think it is the right one.

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