

## Reviewer #1

The manuscript "Errors induced by different approximations in handling horizontal atmospheric inhomogeneities in MIPAS/ENVISAT retrievals" by E. Castelli et al. evaluates several approaches to account for the horizontal atmospheric inhomogeneity. Many limb algorithms assume that the atmospheric parameters and gas concentrations do not vary horizontally along the line of sight. However, this assumption can produce significant errors in the retrieved profiles, especially over latitudes and seasons where large horizontal gradients in atmospheric parameters are observed. In this study authors test several approaches to account for the horizontal inhomogeneity and provide error estimates for each method. This study fits to the scope of the problems considered in AMT. The paper is well organized and written for most of the part. The methods and results are fully explained. The manuscript is recommended for the publication after some minor corrections.

The authors gratefully acknowledge the reviewer for the time spent in reading the paper and for his/her useful suggestions. The authors' reply to each comment is reported in blue below the reviewer's comment.

Specific comments: Throughout the manuscript authors use many acronyms, but not all of them are explained. Please, spell out all acronyms where they are used for the first time in the text. page 2, l.21-23, Please, spell out acronyms 'GMTR', 'MORSE', 'RET2D' and 'RCP'. You use 'GMTR' several times later in the text. Figure 2, Please, spell out 'ORM'.

Done. RET2D, however is defined as "2D retrieval code" but the acronym is never spelled out.

Page 4, Section 2.2, lines 9-15: I found that this part of the section is not clearly written. Did you set the pressure profile to be the same for all latitudes in order to reduce a natural noise and to better isolate an error due to the 1D assumption? Please, explain that in the text.

This is correct. Since the error due to horizontal pressure gradients is very small compared to that owing to the other horizontal gradients (see also reply to related comment of reviewer #2), we set the pressure profile to be horizontally constant to better isolate the error due to the 1D assumption on T and VMR. In the revised version of the manuscript we added a comment on this regard. We added: "For this reason we set the pressure profiles to be latitudinally constant to better isolate the error due to the 1D assumption on the other targets." after the sentence " The vertical distributions of pressure and the other interfering.." in page 4 line 12 of the original manuscript.

Page 7, lines 5-14. I feel this part needs some revisions. For example, the text says "H<sub>2</sub>O RMSEs can be reduced down to 3 % in the 0.1-70 hPa region and to 10 % in the 70-200 hPa region by modeling gradients". By modeling gradients in T or T+VMR? "The error on O<sub>3</sub> reduces to a few percent below 40 hPa and above 0.2 hPa (see Fig. 6)." Why did the O<sub>3</sub> error reduce? Did it reduce as a result of modeling temperature gradients or VMR gradients? "This error can be greatly reduced when atmospheric variability is taken into account (Fig. 4 and Fig. 7)". Did you mean the 1D + gradients approach here or the full 2D retrieval?

We changed the sentence on water vapor: "H<sub>2</sub>O RMSEs can be reduced down to 3 % in the 0.1-70 hPa region and to 10 % in the 70-200 hPa region by modelling gradients" with "H<sub>2</sub>O RMSEs can be reduced down to 3 % in the 0.1-70 hPa region and to 10 % in the 70-200 hPa region by modeling temperature and VMR gradients". In case of O<sub>3</sub> we added "When both the VMR and Temperature gradients are applied, the error on O<sub>3</sub> ..."

For CFCs-11 the sentence "This error can be greatly reduced when atmospheric variability is taken into account (Fig. 4 and Fig. 7)" applies to all the cases analyzed in this work. Thus we changed the sentence in "This error can be greatly reduced when atmospheric variability

is taken into account (Fig. 4 and Fig. 7) using any of the methods described in this study”.

Figure1. Please, add a title on each panel of Fig. 1, for example "Temperature". You have labels on color scales, but they are too small to see.

OK done, we also corrected a typo in the caption and in the text, we removed “H2O” that is not shown in the figure.

Figures 3, 4, 6 and 7: Please, add labels for each color lines. You have these labels on Figs.2 and 5.

OK done.

Figure 5. I would recommend to spell out 'RMSE' here for readers convenience, even though you did that in the text.

OK, in the revised manuscript we spelled out RMSE also in the caption.