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Atmospheric Chemistry and Physics Discussions

Interactive comment on "CO at 40–80 km above Kiruna observed by the ground-based microwave radiometer KIMRA and simulated by the whole atmosphere community climate model" *by* C. G. Hoffmann et al.

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General comments

We would like to thank reviewer Thomas Flury for the helpful comments on our manuscript. We answer the comments point by point below in the same order as given.

Answers to comments on the figures

- Figure 1: The right panel has been removed and the vertical range extended, as requested in the review. The text will be modified accordingly. See also the more extensive answer to the related comment of Hugh Pumphrey.
- Figure 5: We have redesigned Fig. 4, such that the correlation coefficients for the complete time series, as well as the LF and HF parts, are plotted below each other and on the same scale so that they are directly comparable. Figure 5 has been removed. The disadvantage of this style is that it produces large areas of white space in Fig. 4, where the correlation coefficients are large. However, we agree that this is better than the need for another figure showing essentially the same data (Fig. 5).
- New Figure: We do not agree that contour plots of all three datasets improve their comparability. Contour plots of KIMRA and MLS are included in Hoffmann et al. (2011). These plots are indeed useful to see at first glance that major features in the CO time series are similar in the different data sources. However, it is difficult or even impossible to compare individual features quantitatively and on smaller scales with such plots. Therefore, we decided in advance to use line graphs for single altitudes, wherein the consistency of individual variations can be checked more easily by eye. Nevertheless, reviewer Hugh Pumphrey suggested that we repeat these line graphs also for different altitudes, which we have done. Therefore, we have adressed the request to include information over a wider altitude range, but with an alternative way of visualization. (See also the corresponding answer to the comment of Hugh Pumphrey).

Answers to minor comments for the text

- P. 561, line 15: Rephrased in the revised manuscript.
- P. 563, line 25: We agree that a few more general properties of KIMRA should be mentioned in the manuscript and we have added this information to the

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manuscript. Generally, we tried to keep the instrument description short in this manuscript, which is intended to be focused on the model comparison. Many more details about the instrument, measurement properties and retrieval setup have been published separately before by Hoffmann et al. (2011), which is cited in the manuscript.

- P. 564, line 8: We have included some more information on the *a priori* in the manuscript. The *a priori* is constant for the complete dataset, so that all variations seen in the dataset certainly come from the measurements. A winter-mean of a SDWACCM simulations has been used as this constant *a priori*. Note that we have excluded the possibility that the comparison KIMRA-SDWACCM is artificially improved by using a WACCM *a priori* in different ways: 1) by keeping the a priori constant; 2) by the standard averaging kernel analyses shown in detail by Hoffmann et al. (2011); 3) by an additional *a priori* modification experiment, discussed by Hoffmann et al. (2011).

- P. 564, line 27: Rephrased in the revised manuscript.

- P. 565, line 2ff: Figure 1 shows the sensitivity averaged over the complete dataset. This information has been added to the revised manuscript. We have rewriten the discussion of the deviation of the sensitivity from the optimal value to achieve more clarity. Usually, a threshold lower than one of the AVK area is chosen (e.g., 0.8 here) and each altitude in the retrieval with a greater area is considered to be reliable (sensitive range). Minor variations with altitude of the area within the sensitive range are often neglected. This is in general also applied here. However, it turns out, that the variations with altitude explain the shape of the correlation profiles KIMRA-MLS and KIMRA-SDWACCM. Thus, we wanted to make clear in the manuscript that the retrieval at a certain altitude is not either “sensitive” or “not sensitive”. Instead, we highlight the relevance of the smaller sensitivity variations between 40 and 80 km for a detailed interpretation of the

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comparison results.

- P. 565, line 15: Done in the revised manuscript.
- P. 570, line 7ff: $\vec{x}_{\text{independent}}$ has been renamed $\vec{x}_{\text{other}}$. It denotes the MLS, SDWACCM, or SDWACCM AREA profile, respectively. This is now explicitly mentioned.

References

Hoffmann, C. G., Raffalski, U., Palm, M., Funke, B., Golchert, S. H. W., Hochschild, G., and Notholt, J.: Observation of strato-mesospheric CO above Kiruna with ground-based microwave radiometry – retrieval and satellite comparison, Atmos. Meas. Tech., 4, 2389–2408, doi:10.5194/amt-4-2389-2011, 2011.

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