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Comment on amt-2021-115

Anonymous Referee #1

Referee comment on "Phosgene distribution derived from MIPAS ESA v8 data: intercomparisons and trends" by Paolo Pettinari et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-115-RC1>, 2021

Review of "Phosgene distribution derived from MIPAS ESA v8 data: intercomparisons and trends" by Paolo Pettinari et al.

General Comments

In this new study, Pettinari et al. discuss the global distribution and trends of phosgene (COCl₂) measurements by Envisat MIPAS during the years 2002-2012. A comparison of the MIPAS measurements with ACE-FTS and MIPAS balloon measurements is presented. A 10-year trend analysis is shown, and the phosgene trends found in the MIPAS data are related to different contributing factors, in particular to the distribution and trends of CCl₄.

Overall, this is an interesting and carefully conducted study, I think. The manuscript is concise and mostly clear. A few minor suggestions are listed below. In particular, it would be good to add some discussion on how the different vertical resolution of the MIPAS FR and OR modes, the ACE-FTS, and the balloon data affects the results shown here, I think. Once the comments are addressed, I would recommend the paper for publication in Atmospheric Measurement Techniques.

Specific Comments

l19-25: In the abstract, it would be nice to add a sentence explaining the phosgene trends observed by MIPAS, i.e., refer to the trends of CCl₄.

l26-83: The introduction is well written and provides a good overview on the motivation

for the study and on earlier work on the topic, I think.

I94-95: You might add a sentence saying how many vertical profiles are measured each day to provide a number for the "dense coverage".

I135-136: This statement suggests the OR mode retrieval works much better and higher up than the FR mode retrieval. Is it really meaningful to say the phosgene retrieval works up to 54 km, considering the averaging kernels shown in Fig. 2 indicate a reasonable upper limit of about 25-30 km?

I167-168: Can you please provide the actual numbers for the vertical resolution of the FR and OR phosgene retrievals?

Fig. 1: The OR retrievals shows a peak in "pt" errors at 25 km. What is causing this?

Fig. 2: Can you please add a curve showing the integral of the averaging kernels so that it is more easy to see at which height range the retrieval results are mostly determined by information from the measurements rather than a priori data?

Figs. 1 and 2: How do the phosgene retrieval diagnostics change for different atmospheric conditions (tropics, polar summer, polar winter) compared to mid-latitudes?

Fig. 4: At the 50 hPa level, a significant bias/offset seems to be present between the FR and OR measurements. Can you provide an explanation for this offset? Most likely, it is due to the different retrieval characteristics of the FR and OR mode?

I207-209: It would be good to mention the total number of matches/profiles that have been available for comparison.

I210-212: It is pointed out that the MIPAS and ACE-FTS vertical profiles have been interpolated to the same levels to calculate their differences. However, how did you deal with the different vertical resolution of the data sets? Presumably, the vertical resolution of the MIPAS phosgene retrieval is different from the ACE-FTS data? Did you consider that systematic biases will arise in the comparisons due to the different vertical resolution of the data?

l234-238: Could the different vertical resolution of the data sets as represented by the averaging kernel also play a role in this comparison?

l265-273: This section looking at the comparison of the satellite data and the balloon data is also lacking some discussion regarding the (potentially) different vertical resolution of the data sets.

l336: In the conclusions section, it would be nice to include a few sentences about the broader implications of the study. Since MIPAS is out of order for about ten years, are other measurements being available or becoming available sometime soon to continue atmospheric phosgene measurements? Are the MIPAS phosgene measurements particularly important for specific applications in future work, e.g., evaluation of chemistry transport models?

Technical Corrections

l11-25: Merge these five paragraphs of 1-2 sentences each into just one?

l85: "lies" -> "fled" or "operated"

Table 1: apply AMT/Copernicus table format

l187: "polar nights" -> "polar winter" (?)

Fig. 8: the plots are quite small