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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Improved FTIR retrieval strategy for HCFC-22 (CHClF2), comparisons with in situ and satellite datasets with the support of models, and determination of its long-term trend above Jungfraujoch" *by* Maxime Prignon et al.

Anonymous Referee #1

Received and published: 18 April 2019

<General Comments>

This paper describes an improved HCFC-22 retrieval strategy from ground-based FTIR solar spectra at Jungfraujoch. They showed the possibility to distinguish the tropospheric and lower stratospheric partial columns from the FTIR spectra and compared their results with independent datasets (AGAGE and MIPAS) and models (BASCOE CTM and WACCM). However, there are some issues that should be clarified before this paper is published in ACP, which are described in the comments below.

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<Major Comments>

1) I have a concern on comparison between AGAGE (MHD and JFJ) data and FTIR mean tropospheric mixing ratio shown in Section 4.3. First of all, the way to calculate mean tropospheric mixing ratio from FTIR data is not described in detail. I think that SFIT-4 retrieval of FTIR spectra gives total column and vertical profiles with averaging kernel information. How the authors derive mean tropospheric mixing ratio from that information? Do they divide tropospheric HCFC-22 column between station altitude and 11.21 km by the amount of air molecule numbers at the same altitude range? Please explain in the text.

2) Annual variations are seen in both derived total columns (Fig. 3) and tropospheric mean VMR (Fig. 4) in FTIR data, both having peaks in summer to fall. Such annual variations are not seen in AGAGE MHD nor JFJ data. However, there are no explanations nor discussion on the cause of the derived annual variation. I wonder the derived annual variation may come from two reasons: a) The nature of FTIR measurement principle, i.e. measuring column amount above the observational station. The column amount might be affected by the height of tropopause height, which is higher in summer. b) The higher emission of HCFC-22 from the regional summertime use of air-conditioner, as is pointed out by Xiang et al. (2014). Please discuss more about the cause of the retrieved annual variation in FTIR data which are not seen it AGAGE data.

3) The scatter plot in Fig. 4 looks somewhat strange. We see many dots which are horizontally aligned. For example, there are several points for MHD value of $\sim$145, but the next group jumps to >160. However, the actual trend of MHD values look more continuous. Please check if something wrong appeared or not to create this scatter plot.

4) In Section 4.4 (P.8, L.19), the authors claim that they do not show amplitude and phase of the seasonal cycle of tropospheric column series. However, as I mentioned

in the above comment, differences in tropospheric annual variations are seen between FTIR retrieval and AGAGE data. I think they should show the figure which shows amplitude and phase of seasonal cycle of tropospheric columns as well, and discuss on the cause of such variation in more detail.

<Minor Comments/Typos>

1) Throughout the main text: A new paragraph should be indented.

2) Abstract: Even in the Abstract, abbreviation for the following words should be given separately: AGAGE, MIPAS, BASCOE, and WACCM.

3) P.1, L.33: The global warming potential of HCFC-22 should be 1810 (IPCC AR4) or 1780 (WMO O3 Assessment 2018), not 1760.

4) P.6, L.9: Abbreviation for BASCOE should be given.

5) P.7, L.25: data compare very well –> data agree very well

6) P.8, L.2: Is the same altitude range (11.21-30 km) used to create the MIPAS lower stratospheric column? Please clarify.

7) Figure 6: What is the value of the age of air? I think the right hand side axis to show the age of the air is missing.

8) P.9, L.4: mixing ratio series compare –> mixing ratio series agree

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