



EGUsphere, referee comment RC1  
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## **Comment on egusphere-2022-678**

Anonymous Referee #1

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Referee comment on "Retrieval of atmospheric CFC-11 and CFC-12 from high-resolution FTIR observations at Hefei and comparisons with other independent datasets" by Xiangyu Zeng et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-678-RC1>, 2022

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### **General comments**

The manuscript "Retrieval of Atmospheric CFC-11 and CFC-12 from High resolution FTIR Observations at Hefei and Comparisons with Satellite Data" by Zeng et al. describes the retrieval of atmospheric ozone depleting chlorofluorocarbons CFC-11 and CFC-12 from solar absorption spectra measured using a high resolution Fourier Transform infrared spectrometer at Hefei, China, and examines the resulting, multi-year timeseries, and compares it to satellite measurements and concentrations prognosed by a model.

The retrieval scheme builds on work carried out at the St Petersburg NDACC-IRWG (Network for the Detection of Atmospheric Composition Change – InfraRed Working Group) station. The novelty here is the retrieval of these species from the spectra measured at Hefei, representing one of the few measurements of its kind in China. The long-term monitoring of key atmospheric constituents such as these and the understanding of their evolution within a global context is important and the publication of these results should be encouraged.

The manuscript is generally well structured and written but would benefit from further development of several sections to provide more of a thorough description of some of the important concepts as described below under specific comments.

Subject to the incorporation of these changes and the corrections suggested under technical corrections below, publication of this manuscript is recommended.

### **Specific comments**

The manuscript presents retrievals of CFC-11 between January 2017 and December 2020

and CFC-12 between September 2015 and December 2020. The authors should explain why the two observing periods are different.

The abstract states that comparisons are made to other NDACC stations. It should be made clearer whether Hefei is or is not an NDACC-IRWG station. Also make it clear that the comparison is with NDACC-IRWG stations, not other NDACC observations.

The abstract also introduces the comparison to ACE-FTS satellite measurements and WACCMv6 model and presents quotative results of the comparison. It would provide important context here to define the spatial extent of the satellite/model data used i.e., global or coincident with Hefei.

In its current form, Section 2.2. does not provide sufficient information to allow the reader to reproduce the author's results. For example, how was the pseudo line list produced and how can it be obtained? Also, Table 1 lists zshift and beam as background retrieval parameters for CFC-11, but these are not described or explained in the text.

In Section 2.3, How is the measurement error used to refine the regularisation strength determined? This may be covered in the cited article, but it is probably important enough to discuss within the manuscript.

It is unusual to see a column averaging kernel that contains as much structure and sharp transitions as the ones plotted in panel c of Figs 1 and 2. It would be good to include the layer averaging kernels, or a subset thereof, to see how this has come about.

Not all sources of error listed in Table 3 are mentioned in the text of Section 2.5. These sources and the associated assumptions concerning their magnitude should be discussed.

At P10L215, the sentence "The time series are fitted by a lowpass filtered fast Fourier transform (FFT) technology and a linear fitting to simulate the seasonal and interannual variation of CFC-11 and CFC-12 (Thoning et al., 1989)" may not accurately describe the timeseries decomposition process. It appears from Fig. 3 that a linear trend and multi-harmonic seasonal cycle have been fitted. The authors should consider revising this statement and state the number of harmonic terms that have been used to fit the seasonality.

In section 3.1 two retrieval products are discussed: the total columns and near surface concentrations. These products should be introduced prior to their discussion. It would be helpful to do this as part of a discussion of the information content of the retrieval process possibly as its own sub-section in section 2. The error analysis should also state how the

retrieval errors propagate into these two products.

In the conclusions, the statement that "ACE-FTS and WACCM data clearly overestimated the decreasing rate,.. " doesn't appear to be justified in the context of the evidence presented given the spatio-temporal differences between the measurements. This should be revised.

It would be good to see some stronger conclusions drawn, for example placing the findings of this work in the context of previously published findings and a comment on the differing types of emissions that lead to the difference between Hefei and St. Petersburg.

Are there any plans to continue or update the dataset? It would be good to include this information.

### **Technical corrections**

P1L25 in abstract remove % sign after -0.47 to be consistent with the rest of the abstract, elsewhere when expressing a value and uncertainty the parentheses are unnecessary.

P2L56 citation should be Montzka et al., 2021.

P2L57 It might help the reader to know the type of atmospheric observations, in-situ or remote sensing.

P2L60 insert a space between CFC-11 and and.

P2L60 check the units are correct for the emission rates (Gg not kg?) and use  $\text{yr}^{-1}$  to be consistent with the rest of the manuscript

P2L64 "Study of the temporal-spatial distribution and variations of CFCs in the atmosphere is of great significance to reduce stratospheric ozone depletion and greenhouse gas emissions." The study itself does not reduce the emissions, but it does improve understanding and suggest what needs to be done to facilitate reductions. Consider revising this sentence.

P3L80 this sentence may need a change of emphasis, in that HIRDLS, ILAS etc are not mainly used for CFC measurements, but they may be the main instruments used for this type of measurement.

P3L92 Throughout the manuscript there are sentences like this where the un-parenthesised citation is used at the beginning of the sentence with the parenthesised version at the end. It is unnecessary to include the citation twice in one sentence.

P5L141 remove the word time and replace with either iteration or step, i.e., "iteration index i" or "step i".

P9L207 Suggest starting the sentence introducing the error values from the Polyakov study with "At the St Petersburg site..." or similar, to avoid a little confusion.

P9L209 Last sentence should be elaborated

P9 Table 3, This table is a little hard to read, consider more use of horizontal lines to separate items

P10L219 Throughout section 3.1 trends are given the units  $\%/yr^{-1}$  when they should be  $\%/yr^{-1}$  (to be consistent with the rest of the manuscript) or  $\%/yr$

P10L225 Insert a space between -0.49 and %

Figures 3, 4 and 8: Consider using the same x axis scale for both timeseries to allow the reader to see the seasonal cycles aligned.

P13L254 In this discussion, are the seasonal amplitude and variability not the same? I.e., the amplitude in units of molecules per unit area or mixing ratio is also expressed as a percentage of annual mean or detrended mean?

P13L256 consider starting a new paragraph to discuss near surface concentration seasonality

P13L271 CFC-11?

P15L304 It should be explained why the columns of dry-air mole fractions are being compared and not molecules per unit area that were discussed previously. Also, it is not apparent in the text how the dry-air column has been derived.

P16L333 Are global WACCM data used or the same spatial criteria as the ACE-FTS? This should be made clear in the text.

P17 Fig. 8. Check the y-axis label of panel (a)

P17L361 It would make life easier for the reader if the column differences were expressed as a percentage.

P18 Fig. 9. Include the parameters of the linear regression

P18L380 The meaning of the last sentence is unclear. Perhaps: "This is one of the few..."

P19L404 Start a new paragraph for the St. Petersburg comparison.

P19L407 It would be good to go on to describe the emission source differences

References: There are some inconsistencies in formatting of the references, e.g. the use of capitalised journal and article titles, which should be rectified.