

# ***Interactive comment on “CFC-11, CFC-12 and HCFC-22 ground-based remote sensing FTIR measurements at Reunion Island and comparisons with MIPAS/ENVISAT data” by Minqiang Zhou et al.***

## **Anonymous Referee #1**

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The paper by Zhou et al is the first study of the long term trends in the total column of the major atmospheric CFC's 11 and 12, and HCFC 22 from the southern hemisphere. The datasets are from Reunion Island's two NDACC stations using their high resolution FTIR spectrometers. The analysis technique uses the well-established SFIT4 software to give total columns abundances of all three species. The data is compared with collocated satellite measurements which compare quite well and agree within the error budget of the analyses. The trends are derived using a regression model with robust statistical uncertainties. These trends are compared with in-situ data which show qualitative agreement in the overall well established changes in the concentrations of these

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gases.

The paper is therefore technically sound using well established analysis procedures and with a team of researchers that are experts in this field. The paper is well written in general but there are issues with formatting of equations and a few minor typos (outlined below). There is also the need to explain further some areas of the text that are a bit confusing and unclear, but again the particular sections are mentioned below. The paper is suitable for publication in AMT subject to the authors satisfactorily addressing the questions/comments listed below.

Comments/Questions: 1. Page 2, line 74. While it is true that this is the first study of all three species, the authors have missed the only other study from the southern hemisphere of HCFC 22 total columns, namely that of Sherlock et al (1997). This mentioned only in the context that southern hemisphere measurements are so few and far between, which these authors will appreciate.

2. Page 3, lines 109-112. This sentence is poorly constructed, rephrase.

3. Page 3, lines 121-125. The history of the SFIT2/SFIT4 codes is not quit correct here. SFIT2 was certainly developed by the Institutions mentioned, but SFIT4 was largely developed by lead contributors from the University of Bremen and NCAR, with other contributions from several other Institutions within NDACC.

4. Page 4: general comment here, the formatting of the equations needs improving. Line numbers need to be right adjusted without an ending dot or comma.

5. Page 4 line 144, remove extra 'a'

6. Page 4-5, lines 145-179. This is an interesting discussion on the use of channel spectrum fitting in SFIT4. There is little discussion in the literature on the use of this option in high resolution IR spectra so it is very useful here. However the authors discuss this without first explaining why it is necessary in the first place. Clearly this is an issue in some spectra for long wavelength channels. So first establish the problem

(in a sentence or two), and then follow with the explanation of how this is treated in the analysis. In line 161, the maximum number of beams is purely a software choice which can be changed to anything the user wishes.

7. Page 5, line 165, "... are narrow, a linear fit is ..."

8. Page 5 line 170, here is the first mention that channel spectra are necessary to fit. Explain what an IP-type beam is if you think it necessary otherwise leave it out as this implies other choices and will only make sense to established SFIT4 users.

9. Page 5, line 177, "As such an oscillation ..."

10. Page 5, line 192/193, So what you are saying is that for each specific gas and site, there is one respective a priori profile, yes?

11. Page 5, line 197, "... values of the covariance matrix ..."

12. Page 5, line 199/200, this seems a little confusing contrasting the WACCM variability for the covariances (understood) but with a priori profile ensemble. It is not clear what the a priori ensemble is?

13. Page 6, line 209, sensible => sensitive

14. Page 6, line 210-213. With such a relatively poor dofs, what advantage does the profile retrieval bring compared with simple scaling? That is, is there some tangible benefit (does it improve the error budget and other fitting statistics)?

15. Page 6, section 2.2.2, improve the editing of equations, equation numbering etc. Fix issues with symbols (KbEb), and the symbol on line 224.

16. Page 6 line 228, what specifically is ignored? The iteration error?

17. Page 6, line 232/233, specifically put in each term symbol, that is, "...forward model error  $E_f$ , the ..."

18. page 6, line 246, is there a "not" missing, that is, it should read "... but not in the

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model ...”?

19. page 7, line 257, insert comma after Maido.

20. Page 7, line 261, it might be useful to put CFC-11 and HCFC-22 in brackets after the wavelength ranges for clarity.

21. Page 7, line 264, can you say that the offset is actually quantitatively consistent with the pressure difference?

22. Page 7, lines 275-279. These sentences need some editing; “Our FTIR measurements capture the main ... but the scatter in the ... uncertainties of the FTIR measurements. The FTIR columns are also associated with the scatter in the air column ...”

23. Page 8, line 300, Jungfraujoch

24. Page 8, line 303, the end of this sentence makes it a bit unclear. If you do not perform analysis on the Maido data, then remove the “only”. What you are trying to say here is that due to its short time span you only perform the trend analysis on the St Denis data.

25. Page 8, lines 328, 329. This is an interesting dynamic in the data, the apparent cycle in the CFC-12. One might be tempted to point the finger at water but both CFC-11 and HCFC-22 have worse water interference. One would think that any dynamical effect would impact on CFC-11 as well while any chemistry is unlikely here. Do the authors have any ideas?

26. Page 9, formatting of equation 13

27. Page 9, the MIPAS DOFS is clearly larger, and is therefore the one that is smoothed, but for completeness, can the DOFS for MIPAS be mentioned to show why this is so?

28. Page 10, line 387, add "respectively" at the end of this sentence.

29. Page 11, line 418, remove extra comma.
30. Page 11, line 424, add "respectively" after HCFC-22
31. Page 18, table 4 caption, line 603, is there an extra % there?
32. Page 20, figure 1, CFC-11 graph legend, the colour scheme for each of the different gases has not worked, and in the caption, line 618, replace "with" => "by"
33. Page 24, figure 5, is there enough FTIR data to show monthly means rather than individual data? Since the profiles are uniformly mixed in the trop, how far off would a simple calculation of the mean mole fraction be, based on a partial column divided by an partial air column from the pressure (for qualitative not quantitative comparison)?

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