

## ***Interactive comment on “Investigating stratospheric changes between 2009 and 2018 with aircraft, AirCores, and a global model focusing on CFC-11” by Johannes C. Laube et al.***

### **Anonymous Referee #1**

Received and published: 8 April 2020

Firstly, my sincere apologies that this review is arriving so late!

This paper presents novel AirCore measurements of several halocarbons in the stratosphere, and analyses trends in stratospheric trace gases, particularly focusing on CFC-11. The paper is interesting, timely, and the measurement technique shows great promise. I think the paper should be published in ACP, following some (mostly minor) changes.

#### General comments

In general, I think there is quite a lot of material in the supplement that should be in the main text. Particularly given that one of the main purposes of this paper is to

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introduce a new measurement technique, I would encourage the authors to move the experimental details to the main paper, and some of the validation. I think that Tables S2 and S3 should be in the main text, as S2 demonstrates the repeatability of this new technique (which is referred to as a key conclusion of the paper), and the results of S3 are discussed at some length in the main text. Similarly, the brief description of the model setup could also be in the main text, as it is important for readers not familiar with this particular model.

#### Specific comments

The title needs to mention that changes in halocarbons are being referred to.

L34 – 35: “required” is used twice in the same sentence

L40: this first line is too vague. It doesn’t really say anything. I suggest starting with the current second line.

L42: “low to very low” could just be replaced by “low”

L45: “upper limit is around 50km”? Is this suggesting that the stratosphere extends to 50km? Not clear as written.

Section 2 heading: “Methods” are a sub-section of “Results”? I suggest separating these two sections.

L75 and elsewhere: I’m not 100% sure about the grammar here, but I would have thought that a colon followed by a list separated by commas would be more appropriate here (after “platforms”)

L80 – 83: As mentioned above, I think this needs much more explanation, and I would bring in a lot of the supplementary information.

L84: “good precision” needs quantifying. Perhaps compare to the precision of other measurement techniques and say whether it is comparable or not (avoid subjective terms like “good”).

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L88: AoA is defined later on (L125). Needs to be introduced here. Furthermore, I would suggest a brief paragraph here explaining the concept, and calculation method.

L90: I found this description too hard to follow. When were second or third order polynomials used? What exactly was being fitted? What is the purpose of “quintupling” the data, etc.? I think you need to walk the reader through this more gently. A figure may help to demonstrate the technique.

L134: what does “times inside the stratosphere” mean? Do you mean AoA?

L174: Given that this line is at the start of a paragraph, I think you need to re-state what each part of the sentence refers to. I.e. a positive trend in what? Explain “all observation based cases”.

Figure 3: The conclusions drawn from this analysis, namely that there has been no trend, or a positive trend, seems highly dependent on a small number of points in 2009 – 2011. Can the authors comment on this? Are we really confident that the observations can provide strong conclusions about the overall trend, given that there are large periods of these time series with no data (i.e. nothing between ~2011 and 2016)? Some softening of the discussion of the observation-based trend would seem warranted to me.

L175: as stated above, having Table S3 in the main text seems important to understand this sentence.

L187: For clarity, I suggest adding: “In contrast, in the stratosphere, we find . . .”

L195 – 204: I must admit to finding it very challenging to follow this explanation, despite reading over it three or four times. I realise it’s a complicated business, but I suggest that the authors re-word, or, better, provide a schematic outlining their argument.

L197: I suggest: “. . . HCFC-22, which is much longer lived in the stratosphere” (it’s shorter lived overall).

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Section 2.4: I’m sure this highlights my ignorance, but doesn’t it seem counterintuitive to have an increased mass flux from the stratosphere to the troposphere at the same time as an increase in stratospheric CFC-11? Can you add a couple of sentences explaining why this would be?

L230: “ratio”, rather than “ratios”

Figure 4 caption: Specify which direction the flux is in (I think it strat to trop?).

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-62>, 2020.

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