

Interactive comment on “Perfluorocyclobutane (PFC-318, $c\text{-C}_4\text{F}_8$) in the global atmosphere” by Jens Mühle et al.

Anonymous Referee #2

Received and published: 29 May 2019

The manuscript entitled “Perfluorocyclobutane (PFC-318, $c\text{-C}_4\text{F}_8$) in the global atmosphere” by Mühle et al. has been evaluated by this reviewer. The paper presents a substantial piece of measurement and modeling work on the atmospheric abundance and emission rates of perfluorobutane. The authors have developed an independent gravimetric $c\text{-C}_4\text{F}_8$ calibration scale and characterized the abundance of $c\text{-C}_4\text{F}_8$ with high precision in both hemispheres in order to determine historical emissions (archived samples) and recent global emissions. Using inversion modeling techniques, regional emission patterns (and pollution events) are investigated in detail, revealing that major $c\text{-C}_4\text{F}_8$ sources are found in heavily industrialized provinces of China (and perhaps Russia), due to the production of PTFE and other fluoropolymers. They predict $c\text{-C}_4\text{F}_8$ emissions will continue to rise and that $c\text{-C}_4\text{F}_8$ will become the second most important

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PFC emitted to the atmosphere in terms of CO₂ equivalent emissions.

General Comments: The manuscript is a pleasure to read, has very few technical errors, and presents and an impressive amount of interesting data. The authors have done a commendable job to present a succinct and encompassing description of the methods and the results. The conclusions follow elegantly from the data presented and form a compelling narrative, especially considering the magnitude of difference in the potential emissions sources involved. I have only few scientific comments/questions. Those are listed below here, followed by technical (suggested) corrections:

Specific Comments: L55: "... explaining the increase in emissions." Presumably the authors here refer to the early/pre 1980's? L65: "Significant emissions" must be inferred significant emissions? L115: What is "aerolyzed foods"? Please explain (very briefly), or used more common term. L262: Please explain what is meant by "above bubble close-off". L.396-397: "it was assumed that emissions were constant from year to year". This seems confusing to me. Perhaps I'm not understanding this inversion correctly. I can see that the emissions would be assumed constant during the year, but why from year to year? How does this work? L440: "We do not report emission estimates outside of eastern Asia due to large posterior uncertainties but include them assisted with determination of the boundary conditions". I don not understand this approach. Please clarify and explain. L538: Please explain why not incorporating the firn data has this impact on the emissions estimates. L547: How can the mole fractions of this very unreactive compound change in the tanks? L553: C₂F₆ is here listed as a minor PFC, however in L122, it was a major. Which are the majors and the minors? L558: To make clear what we are talking about, I suggest inserting "from a climate forcing standpoint" before "will become the second most important PFC. ...".

"Technical" Comments: L42-43: The propagated uncertainties on the emissions should be given in the abstract. L61: " in agreement with our analysis". This seems like an obvious statement. Suggest deleting. L102: "Recently there is also further evidence. ...". This sentence begins awkwardly – suggest rewording it. L249: "Fig.1." Other places

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in the manuscript “Figure” is used. Check for consistency. L302: Perhaps “default” is a better word in place of “definition”. L311: Move the definition of $1t = 0001Gg$ to the introduction paragraph, where Gg is first used. L316: replace “similar to” with “analogous to what has been observed for”. L641: Insert “occurring” before “. . .in China. . .) Line 689-691: These two sentences belong more appropriately in sections 5.35 and 5.3.6.

Figures: Figures 1 is nicely formatted, but the formatting is inconsistent with that applied in Figures 2-4. Moreover Figure 5 has a completely different formatting style. This figure formatting ought to be “harmonized”.

Figure 1 caption: What are the error bars?

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