

Interactive comment on “Atmospheric abundance and global emissions of perfluorocarbons CF₄, C₂F₆ and C₃F₈ since 1900 inferred from ice core, firn, air archive and in situ measurements” by Cathy M. Trudinger et al.

Anonymous Referee #2

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I find this to be an excellent, well written manuscript that can be published with little or no change. The subject matter is relevant, the analyses based on high-quality measurements, and the models rigorously tested and checked. The figures are clear with appropriate captions, and well organized. Collectively they strongly support the text and make clear the various steps necessary in such an analysis. Deriving atmospheric histories from measurements of gas trapped in firn is a challenge that requires careful attention to biases and uncertainties. The authors have paid close attention to just about every detail of this study, including testing the model at several locations with different firn properties, verifying diffusivity in the firn at each site with atmospheric his-

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tories, comparing measurement results of these very low concentration gases on different instruments with different operators, evaluating the Green's functions with different approaches, and testing and combining different models to understand the impact of choice on overall uncertainty. What has resulted is a largely believable, robust set of atmospheric histories for these three strong climate forcing gases, and the authors should be commended for this work.

It's a minor point, but I do have a concern about the authors' use of the phrase "late-Holocene, pre-industrial" in describing their measurement records. The Holocene era goes back about 10,000 years and "pre-industrial" is meant in IPCC and other documents to capture years before 1750. It's a leap of faith, albeit a small one, to say that what is observed around 1900 represents what the atmosphere looked like before 1750. I've seen papers that use 1800 to describe "pre-industrial", but never 1900, the years after which capture the domain of this study. They might want to prefer describing their data set as a "20th century" or a "late 19th through 21st century" record to be more representative.

My other concern is that, in testing the diffusivity of the various sites they only used one data point for South Pole. Butler et al. (1999) published records of several gases in South Pole firn-air which suggested that independently derived (i.e, inventory driven) atmospheric histories were consistent with observed firn-air distributions. It would have been instructive to use those same depth profiles of, say, CFC-11 and CFC-12, to test the diffusivity throughout the South Pole firn profile for this study as well, even though they only had one data point from that study. Also, the Butler et al (2001) study referenced in this paper included an additional set of depth profiles of the same gases that could have been used in the same way. Finally, an archive of ~10 large cylinders of firn air was collected for future analyses. If the one from 120 m could be measured for these perfluorocarbons, I would think that the others could have been as well.

I do not consider any of these items to be show stoppers. This is an excellent paper and deserved to be published.

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