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Comment on acp-2021-857

Anonymous Referee #4

Referee comment on "Global emissions of perfluorocyclobutane (PFC-318, *c*-C_4F_8) resulting from the use of hydrochlorofluorocarbon-22 (HCFC-22) feedstock to produce polytetrafluoroethylene (PTFE) and related fluorochemicals" by Jens Mühle et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-857-RC4, 2022

This paper provides a valuable addition to the literature linking the pyrolysis of HCFC-22 feedstocks to c-C4F8 by-product emissions measured in the atmosphere. The paper is well-written. The explicit comparison to global feedstock supplies and derivation of a global emission factor is new and support the conclusion that pyrolysis of HCFC-22 is the dominant source of c-C4f8 in the atmosphere. The link to feedstock production in developing countries is interesting and provides a useful estimate of overall emission factor from the sector in developing countries.

Specific comments:

The paper would however benefit from discussing other sources of c-C4F8 in a quantitative manner if possible. The intercept from Figure 3 from global production of HCFC-22 feedstock suggests a significant other source. Emissions of c-C4F8 from semiconductor manufacturing, largely from consumption of c-C4F8 for etching processes, are small but not insignificant and could account for a large portion of the background. In 2018, WSC reported emissions of ~0.13 Gg (https://www.eusemiconductors.eu/sites/default/files/23rdWSCJoint-Statement_May2019Xiamen-TOC_FINAL.pdf). Total emissions of c-C4F8 from the electronics sector may be larger, as this estimate does not include emissions from PV, LDC or MEMS. Use of c-C4F8 in the semiconductor industry started increasing at about the same time as the increase of C4F8 in the atmosphere (early 2000s – see Francesca Illuzzi & Harry Thewissen (2010) Perfluorocompounds emission reduction by the semiconductor industry, Journal of Integrative Environmental Sciences, 7:sup1, 201-210, DOI: 10.1080/19438151003621417). On page 8 of this manuscript, you refer to the possibility of significant emissions from the semiconductor industry between 1996 and 2001, but this seems unlikely. No emissions of C4F8 were reported to the US EPA prior to 2002.

Considering that there was a large dip in production of HCFC-22 in 2009 but an increase in emissions, this may be evidence that the by-product emissions from Annex 5 countries and China is greater than for developed countries, as these two regions had only a minor decrease or an increase (China) in 2009 or alternatively that there was not a corresponding drop in production for other c-C4F8 sources. There was also a dip in production in 2015 (China + A5) but no corresponding dip in emissions. Appears to instead be large increase. There was a corresponding increase in c-C4F8 emissions in S. Korea in your previous paper (Muhle 2019) and in US emissions from the semiconductor industry (EPA 2020). Even if the authors are not sure of the source of these differences in trends, it would be useful to discuss the possible sources.

Other typographical/formatting comments:

For Figure 2, it would be useful to include the black diamonds in the legend. It also appears that the emissions data is offset on the x-axis compared to the production data, making it appear that there are two additional years of emission data compared to production data (but there is only one additional data point). It would be easier to read if they were not offset.