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Comment on acp-2021-222

Anonymous Referee #1

Referee comment on "Trifluoroacetic acid deposition from emissions of HFO-1234yf in India, China, and the Middle East" by Liji M. David et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-222-RC1>, 2021

This paper reports the results of a modeling study of the formation and deposition of trifluoroacetic acid (TFA) following the atmospheric oxidation of HFO-1234yf ($\text{CF}_3\text{CF}=\text{CH}_2$) emitted in India, China, and the Middle East. The concentrations of trifluoroacetic acid expected in precipitation are shown to be in a similar range to those estimated for emissions of HFO-1234yf in North America, Europe, and China (Henne et al., 2012; Kazil et al., 2014; Luecken et al., 2010; Wang et al., 2018). Similar to the previous studies modeling emissions in North America and Europe it is concluded that deposition of trifluoroacetic acid following the atmospheric oxidation of HFO-1234yf emitted in India, China, and the Middle East has a negligible impact on human or ecosystem health. I recommend publication after the authors have considered the following minor comments.

(1) Line 56, the latest GWP estimate for HFC-134a is 1,600 (Hodnebrog et al., 2020).

(2) Line 65, allowance for the decomposition of chemically activated CF_3CFHO radicals needs to be made in assessing the yield of CF_3COF and hence trifluoroacetic acid from the atmospheric oxidation of HFC-134a (Wallington et al., 1996). Hence, the yield of TFA from atmospheric oxidation of HFC-134a is substantially lower than 30%.

(3) The negligible impact of TFA formation during the atmospheric oxidation of HFCs, HCFCs, and HFOs has been established for some time. In 2007, the WHO Ozone report concluded "trifluoroacetic acid from the degradation of HCFCs and HFCs will not result in environmental concentrations capable of significant ecosystem damage". In 2008, Hurley et al. concluded that "the products of the atmospheric oxidation of $\text{CF}_3\text{CF}=\text{CH}_2$ have negligible environmental impact". In 2016, Solomon et al. concluded that "concentrations of TFA and its salts in the environment that result from degradation of HCFCs, HFCs, and HFOs in the atmosphere do not present a risk to humans and environment". Although some of these are cited in the latest review by Neale et al. (2021) which is cited, it would be appropriate to explicitly mention these previous reports for context.

References

Henne, S., Shallcross, D. E., Reimann, S., Xiao, P., Brunner, D., O'Doherty, S. and Buchmann, B.: Future emissions and atmospheric fate of HFC-1234yf from mobile air conditioners in Europe, *Environ. Sci. Technol.*, 46, 1650–1658, 2012.

Hodnebrog, Ø., Aamaas, B., Fuglestad, J. S., Marston, G., Myhre, G., Nielsen, C. J., Sandstad, M., Shine, K. P., and Wallington, T. J.: Updated global warming potentials and radiative efficiencies of halocarbons and related compounds, *Rev. Geophys.*, 58, e2019RG000691, 2020.

Hurley, M. D., Wallington, T. J., Javadi, M. S., and Nielsen, O. J.: Atmospheric Chemistry of $\text{CF}_3\text{CF}=\text{CH}_2$: Products and Mechanisms of Cl Atom and OH Radical Initiated Oxidation, *Chem. Phys. Lett.*, 450, 263-267, 2008.

Kazil, J., McKeen, S., Kim, S. W., Ahmadov, R., Grell, G. A., Talukdar, R. K. and Ravishankara, A. R.: Deposition and rainwater concentrations of trifluoroacetic acid in the United States from the use of Hfo-1234yf, *J. Geophys. Res.*, 119, 14,059-14,079, 2014.

Luecken, D. J., Waterland, R. L., Papasavva, S., Taddonio, K. N., Hutzell, W. T., Rugh, J. P. and Andersen, S. O.: Ozone and TFA impacts in North America from degradation of 2,3,3,3- tetrafluoropropene (HFO-1234yf), A potential greenhouse gas replacement, *Environ. Sci. Technol.*, 44, 343–348, 2010.

Solomon, K. R., Velders, G. J. M., Wilson, S. R., Madronich, S., Longstreth, J., Aucamp, P. J., Bornman, J. F.: Sources, fates, toxicity, and risks of trifluoroacetic acid and its salts: relevance to substances regulated under the Montreal and Kyoto Protocols. *J. Toxicol. Environ. Health. Part B, Crit. Rev.*, 19, 289-304, 2016.

Wallington, T. J., Hurley, M. D., Fracheboud, J. M., Orlando, J. J., Tyndall, G. S., Sehested, J., Møgelberg, T. E., and Nielsen, O. J.: Role of excited CF_3CFHO radicals in the atmospheric chemistry of HFC-134a, *J. Phys. Chem.*, 100, 18116-18122, 1996.

WMO (World Meteorological Organization), 2007. Scientific Assessment of Ozone Depletion: 2006, Global Ozone, Research and Monitoring Project – Report 50, Geneva, Switzerland.

