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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 ($CF_3CF=CH_2$)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).
The GWP value is updated in the revised manuscript (Lines 56-57).

(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 theatmospheric oxidation of HFC-134a (Wallington et al., 1996). Hence, the yield of TFA from atmospheric oxidation of HFC-134a is substantially lower than 30%.
Thank you for the comment. We have added the following lines in the revised manuscript (Lines 65-68):
"Later research (Wallington et al., 1996) shows that hot CF3C(O)H formed in the degradation scheme would reduce the TFA yield from HFC-134a. This reduction is not explicitly considered here, but we acknowledge that the noted TFA yields from HFC-134a can be viewed as upper limits."

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 CF3CFHO radicals in the atmospheric

chemistry of HFC-134a, J. Phys. Chem., 100, 18116–18122, doi:10.1021/jp9624764, 1996.

(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 $CF_3CF=CH_2$ 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.
Thank you for the comments. We have adopted the suggestion of the reviewer (verbatim!), and we have added the following lines in the revised manuscript (Lines 488-496).
"The negligible impact of TFA formation during the atmospheric oxidation of HFCs, HCFCs, and HFOs has been established for some time. The WMO/UNEP Quadrennial Ozone Layer Assessment (2007) report concluded that TFA from the degradation of HCFCs and HFCs would not result in environmental concentrations capable of significant ecosystem damage. Hurley et al., (2008) concluded in their study that the products of the atmospheric oxidation of CF3CF=CH2 will have negligible environmental impact. Solomon et al., (2016) also concluded in their study that the 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."

Hurley, M. D., Wallington, T. J., Javadi, M. S. and Nielsen, O. J.: Atmospheric chemistry of CF3CF=CH2: Products and mechanisms of Cl atom and OH radical initiated oxidation, Chem. Phys. Lett., 450, 263–267, doi:10.1016/j.cplett.2007.11.051, 2008.

Solomon, K. R., Velders, G. J. M., Wilson, S. R., Madronich, S., Longstreth, J., Aucamp, P. J. and 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. Heal. Part B, 19(7), 289–304, doi:10.1080/10937404.2016.1175981, 2016.

WMO/UNEP Quadrennial Ozone Layer Assessment: Scientific Assessment of Ozone Depletion: 2006; WMO: Geneva, Switzerland, , 50, 572, 2007.

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 airconditioners in Europe, Environ. Sci. Technol., 46, 1650–1658, 2012.

Hodnebrog, Ø., Aamaas, B., Fuglestvedt, J. S., Marston, G., Myhre, G., Nielsen, C. J., Sandstad, M., Shine, K. P., and Wallington, T. J.: Updated global warming potentials andradiative 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 Chemistryof $CF_3CF=CH_2$: 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 theUnited 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 of2,3,3,3- 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.