

Interactive comment on “Evaluation of stratospheric age-of-air from CF₄, C₂F₆, C₃F₈, CHF₃, HFC-125, HFC-227ea and SF₆; implications for the calculations of halocarbon lifetimes, fractional release factors and ozone depletion potentials” by Emma Leedham Elvidge et al.

Anonymous Referee #3

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This is an interactive review of the paper titled “Evaluation of stratospheric age-of-air from CF₄, C₂F₆, C₃F₈, CHF₃, HFC-125, HFC-227ea, and SF₆; implications for the calculations of halocarbons, fractional release factors and ozone potentials”, by Elvidge et al for the journal Atmospheric Chemistry and Physics Discussions. This paper represents an important work that presents the tropospheric trends and stratospheric measurements of 7 trace gases, and their potential to estimate stratospheric mean ages and should be published. Their measurements confirm the results of Ray

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et al. (2017) that the atmospheric lifetime of SF₆ should be reduced from 3200 years, and it is more like the lifetime of HFC-227ea. Another important result of this paper is that the reported atmospheric lifetime of HFC-125 may be wrong. The error analysis for the age of air, new estimates of FRFs and ODPs, and new stratospheric lifetimes for many ODSs also are of value to the scientific community.

Minor points to address:

1. The authors point out the potential troubles using CO₂ as a “mean age of the stratospheric air mass” tracer, because of its strong seasonal cycle and hydrocarbon source. But, there is also a small mesospheric sink for CO₂ that produces CO. What is the best literature estimate for the atmospheric lifetime of CO₂? Infinite? Cannot these potential effects be easily estimated or considered small? It seems that CO₂ is still the best estimate of mean age of air, because it has an infinite atmospheric lifetime.
2. The trace gas, SF₆, still is an excellent mean age of air in regions outside the influence of polar air masses and fine for polar air during periods without vertical descent. The qualitative evidence to suggest potential SF₆ outside the polar vortex is weak, unless you model the transport. I would recommend dropping it.
3. What are the sinks for these seven gases? Mesospheric sink? Can the Ray et al., (2017) technique be used to calculate their lifetimes too?
4. If the recommended lifetime of HFC-125 is questioned by this work, could the recommended lifetime of HFC-227ea also be wrong. Perhaps the HFCs are not the best lifetime standard after all to compare to SF₆.
5. I don't agree with the sentence in the text, how does qualitative evidence go to substantial evidence. I suggest the following “However, we do provide additional new evidence for the need of caution when using SF₆ to derive mean ages, particularly in regions influenced by polar vortex descent (Ray et al., (2017)).”

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