

***Interactive comment on “Evaluation of stratospheric age-of-air from CF<sub>4</sub>, C<sub>2</sub>F<sub>6</sub>, C<sub>3</sub>F<sub>8</sub>, CHF<sub>3</sub>, HFC-125, HFC-227ea and SF<sub>6</sub>; implications for the calculations of halocarbon lifetimes, fractional release factors and ozone depletion potentials” by Emma Leedham Elvidge et al.***

**Anonymous Referee #1**

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This paper considers the use of a set of long-lived chemical species that might be alternatives to SF<sub>6</sub> and CO<sub>2</sub> as 'age-of-air tracers'. The uncertainties involved in the corresponding age-of-air calculations are assessed. A 'best-estimate' mean age calculated from five of the species is compared to that calculated from SF<sub>6</sub> and shown to be in good agreement for ages less than about 3 years, but systematically less than that calculated from SF<sub>6</sub> for ages longer than that. It is suggested that this difference is likely to be the effect of mesospheric depletion of SF<sub>6</sub> and the fact that air samples

taken in the stratosphere inevitably contain a small proportion of air that has previously visited the mesosphere.

Stratospheric lifetimes, fractional release factors and ODPs of a set of ozone-depleting species are calculated on the basis of the 'best-estimate age' and compared to the values from previous similar calculations with SF<sub>6</sub>-based age of air and to the values recommended in WMO2014.

This paper seems a worthwhile and interesting contribution to me and I recommend publication after revision to address the detailed comments below.

I4-5: 'proxy for the rate of the stratospheric mean meridional circulation' and 'proxy for' and 'rate of' seem odd (second more than first). 'measure' or 'indicator' 'of the strength of' would be more usual.

I21: 'The reduction in SF<sub>6</sub> lifetime' should surely be 'The evidence for reduction in SF<sub>6</sub> lifetime'.

I41: 'it must therefore be reliable ... throughout the stratosphere' actually by 'reliable' you mean 'largely chemically inert' (the term you have used on I14), so I suggest you use the latter term. Actually 'largely chemically inert' could surely be more precisely stated as something like 'rate of chemical change in stratosphere (and mesosphere) is much smaller than rate of chemical change in troposphere'?

I71: 'We believe the lifetime ...' you should give at least a very brief indication of WHY you believe this.

I81: 'all compounds' > 'all of the seven compounds to be considered'

I100: 'agrees very well with Advanced Global Atmospheric Gases Experiment' give a reference for this experiment or the data that comes from it.

Figure 1: The black vertical lines are very small.

I134: To be clear, are you saying that the CF<sub>4</sub>, C<sub>2</sub>F<sub>6</sub> and SF<sub>6</sub> data from AGAGE was

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NOT used?

I136: 'in this manuscript' > 'used in this manuscript'

I169: 'Mean ages were calculated using the parametrisation described in Boenisch et al (2009).' – actually Boenisch et al (2009) say 'This two step method that we applied here for stratospheric mean age of air calculation from SF6 observation is explained in detail by Engel et al. (2006b).' – so you should surely give the Engel et al (2006b) as the reference for the method used? But the way in which you provide information on the method used is generally rather confusing and needs to be improved. In the following paragraph you give some further comments on the method and refer to another paper by Engel et al (2002). Then you give further details in section 3c – which to some extent repeats what has already been said in the paragraph I195-202. I think that it is very important to give these sorts of details of the method (including testing the sensitivity to the value of the ratio  $\text{width}^2/\text{mean age}$ ). But at present the way that these details is disjointed and, as noted previously, the references to previous work, where the reader might find more detail are not very clear.

I176: 'using values' > 'using values of the above ratio'

I260: I've already noted that this text repeats to some extent what was said in I189-202. It is not necessarily a bad thing to repeat important points, but as noted earlier, I think that the whole presentation of methods could be clearer. Perhaps, for example, it would be more effective to combine the description of each part of the baseline method with the method(s) for the corresponding uncertainty test in Section 2, and then discuss the results of the uncertainty tests and make further comments in Section 3.

I297: 'We use CFC-11 as a vertical coordinate because it is an inherent property of the measured air parcel and will be similarly influenced by transport and mixing' – 'similarly' to what – I guess that you mean 'similarly to the other six tracers' but please clarify. In any case I don't really follow the logic here – aren't the other six tracers also 'inherent properties of the measured air parcel' – so why is CFC-11

special? (I don't see a problem with the use of CFC-11, I just don't follow the logic.'

I393: It would be helpful if you included a brief comment on the information that was used to generate the WMO (2014) recommended values of lifetimes, FRFs and ODPs. Was this a combination of model and observational information? How did it differ from the information used to generate the values in Laube et al (2013)?

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