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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Atmospheric Lifetimes, Infrared Absorption Spectra, Radiative Forcings and Global Warming Potentials of NF_3 and CFC-115" *by* Anna Totterdill et al.

Anonymous Referee #1

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Interactive comment on "Atmospheric Lifetimes, Infrared Absorption Spectra, Radiative Forcings and Global Warming Potentials of NF3 and CFC-115", by Anna Totterdill et al.

This manuscript discusses updated measurements of infrared absorption spectra of NF 3 and CFC- 115, and calculates the radiative forcing and efficiency of these molecules taking into account the impacts of clouds and stratospheric adjustment. The WACCM model is used to calculate atmospheric lifetimes, and global warming potentials for NF 3 and CFC-115 are also reported. The results of this study are important and will feed into the IPCC and WMO ozone assessment activities. The scope of the paper is clearly relevant for publication in ACP. There are a few issues outlined below which the authors should consider before publication (I have taken into account the authors' corrections

posted on 6 May).

Specific Comments:

p. 2, L19: this should be stated as "based on the previous O(1 D) reactive yield from Sander et al." – "based on previous photolysis cross sections" was incorrectly stated in the SPARC (2013) report. The CFC-115 cross-sections used in SPARC (2013) were unchanged from Sander et al. (2011).

p. 3, L16: suggest changing "It" to "WACCM". Also, I recommend removing "revised" from this sentence. Stating that these are "revised" estimates of the lifetimes implies that the new values supersede those in SPARC (2013). However, this would require a more in-depth analysis of the updated loss rates than is presented in the paper, i.e., showing that the new loss rates are improved over previously reported vales (see comment below regarding the photolysis rates), and the authors also show that the impacts of the metal reactions (which were not addressed in SPARC (2013)) are negligible.

p. 4, L30-32: In the discussion of the photolysis cross sections, there is no reference of a recent study by Papadimitriou et al. (GRL, 2013, pp. 440-445) who reported updated laboratory measurements of NF 3 photolysis cross sections (these results were also reported in SPARC (2013). The Papadimitriou et al. study showed the importance of the 200-220 nm region for NF 3 photolysis. However, the present paper states that the cross sections used in WACCM are only for 121.6-200 nm based on their previous studies. Neglecting the 200-220 nm region could cause the differences in the NF 3 lifetime and fractional loss contributions discussed on p. 7 and in the Conclusions. The authors should at least briefly mention this point and how the cross sections they used differ from the Papadimitriou et al. study (more specifically than just the general statement at the bottom of p. 7).

I have a similar comment in regards to the CFC-115 cross sections. Please provide a brief statement as to how the values from the previous Totterdill et al. studies used in WACCM differ from current recommended values (Sander et al., 2011 or IUPAC), and

why the 200-230 nm range was not included. SPARC (2013) reported that the 190-230 nm region accounted for 28% of the total CFC-115 loss.

p. 4, L32 - p. 5, L 2: the authors state that they are running the model to steady state, however, it appears that they are using time dependent solar forcing, as opposed to a fixed average solar forcing. Perhaps the time dependent solar forcing does not impact the lifetimes? Please clarify.

p. 5, L26: please provide some justification for the assumption that the temperature dependence contributes negligible uncertainty, eg, is this the case for other molecules?

p. 8, L9-12: should also include that the tropopause can be defined by potential vorticity. How would a tropopause defined by PV impact the radiative forcing calculations? Perhaps the results would be similar to the thermal definitions, but this should be stated.

p. 9, L1: "Figure 7" – this appears to be labeled as Figure 6, and shouldn't this come after the figure currently labeled Figure 7?

p. 9, L3: "The latitudinal variation....as large as a factor of 8". Please be more specific here - is the "factor of 8" the equator-SPole difference?

p. 9, L6-7: "..primarily due to changes in the Planck function." Please provide a little more explanation as to why this is so, e.g., is this due to latitudinal changes in the background ambient temperature?

p. 9, L7-8: regarding the 25% difference in the SH vs. NH. Again, can you provide a little more explanation as to why this is, eg, is this due to the very cold temps of the SH polar vortex? Perhaps this is being implied in the next sentence, but it should be more directly stated.

Technical Corrections:

p. 3, L20: "...some deviation across existing the literature cross-sections" should be corrected – it's unclear what is being said here.

p. 4, L14: "5.96x10-6 Pa" – to help orient the reader, also include the corresponding approximate altitude, ie, $\sim$140 km, judging by Fig. 3.

p. 7, L4: "..tracers to mix vertically into this region." To clarify, I suggest adding "due to the dominance of molecular diffusion" to the end of this sentence.

p. 7, L12: change "CFC-115 uses 1.05 and ..." to "CFC-115 are 1.05 and..."

p. 7, L14: the TTL is $\sim$12-17 km (or there abouts). 20-28 km is much too high.

p. 7, L15: add "mixing" before "ratios"

p. 7, L17: "(see next)" – what does this refer to? The next figure?

p. 8, L4: change "cloud is" to "clouds are"

p. 9, L16-17: add "is" before "obtained"

p. 9, L27: change "gases changes" to "gas changes", and include "a" before "cloud"

p. 9, L29: change "cloud is" to "clouds are"

p. 11, L7: change "cloud" to "clouds"

p. 16-17, captions for Tables 2-3: to clarify, I suggest adding "IR" after "Integrated"

Fig. 4, top 6 panels: it would be more informative to present the losses as mixing ratio/year instead of Tonnes/year.

Fig. 4, bottom 4 panels: to clarify, please add "total" in all figure titles, e.g: "Ratio of total NF3 loss via photolysis(%)"

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