RE-EVALUATION OF THE LIFETIMES OF THE MAJOR CFCS AND CH_3CCL_3 USING ATMOSPHERIC TRENDS

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LIFETIMES OF HCFCS AND HFCS

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Following the phase-out of chlorofluorocarbons (CFCs), there has been a rapid growth in the use of hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) in applications that CFCs were used for (e.g. refrigeration). These compounds are less destructive to stratospheric ozone than CFCs because of their lower (or zero) chlorine content and because they are largely destroyed in the troposphere. Their tropospheric destruction occurs primarily through reaction with the hydroxyl radical (OH).

In this section, we have used the OH fields that were generated in our inversion using AGAGE observations to estimate the resulting steady-state lifetime of the most abundant of these compounds. Stratospheric lifetimes for each species were based on the estimates of Naik et al. (2000) and reaction rates with OH were taken from Sander et al. (2011). No oceanic sinks were assumed. Steady-state lifetimes were estimated using the methodology outlined in the main text. Approximate uncertainties are derived from the uncertainty in the OH field, although uncertainties due to stratospheric losses and reaction rates with OH are neglected. Estimates of the OH uncertainty include the measurement and modeling uncertainties derived in the inversion, and an estimate of the uncertainty due to the assumed CH_3CCl_3 stratospheric and oceanic lifetimes (which we assumed to be accurate to approximately 30% and 37% based on Park et al. (1999) and Butler et al. (1991) respectively). Lifetimes of CH_3CCl_3 and CH_4 are included for reference. A 120 year stratospheric lifetime was assumed for CH_4. Also shown are the partial steady-state lifetimes with respect to OH losses.

Table 1. Global steady state lifetimes and lifetimes with respect to OH loss for the major HCFCs, HFCs, CH_3CCl_3 and CH_3.

Gas	Steady-state global lifetime (years)	Steady-state lifetime w.r.t. OH loss (years)	1-sigma uncertainty due to OH field (approx, years)
CH_3CCl_3	5.04	6.16	0.18
CH_4	9.7	10.6	0.4
HCFC-22	12.2	13.09	0.5
HCFC-141b	9.18	10.76	0.4
HCFC-142b	17.36	19.53	0.8
HFC-23	251.12	281.75	10
HFC-32	5.34	5.7	0.23
HFC-125	28.82	32.74	1.2
HFC-134a	13.7	14.58	0.6
HFC-143a	47.36	55.43	2.3
HFC-152a	1.57	1.64	0.07
HFC-227ea	36.32	38.54	1.6
HFC-245fa	7.99	8.47	0.34

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