

# Supplementary Material for “Uncertainty analysis of projections of ozone-depleting substances: Mixing ratios, EESC, ODPs, and GWPs”

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Table S1. Effect of uncertainty in lifetimes on the year EESC returns to 1980-levels for mid-latitude and Antarctic conditions. Shown are the median and upper and lower uncertainties (95% confidence interval, as difference from the median). All values are given in years.

	Mid-latitude conditions				Antarctic conditions			
	Possible range		Most likely range <sup>a</sup>		Possible range		Most likely range <sup>a</sup>	
Base run model (median)	2048				2075			
Species mainly removed in the stratosphere								
CFC-11	-3.4	+3.8	-1.8	+2.0	-6.0	+9.0	-3.3	+4.3
CFC-12	-1.4	+1.7	-0.7	+0.8	-4.6	+6.7	-2.5	+3.0
CFC-113	-0.4	+0.6	-0.2	+0.2	-1.2	+1.6	-0.5	+0.6
CFC-114	0.0	0.0			0.0	0.0		
CFC-115	0.0	0.0			0.0	0.0		
CCl <sub>4</sub>	-1.3	+1.6	-0.9	+1.1	-1.4	+2.2	-1.0	+1.4
Halon-1301	-0.3	+0.4	-0.2	+0.3	-1.1	+1.3	-0.8	+0.9
All of this group combined <sup>b</sup>								
Uncorrelated ( $\gamma = 0$ )	-4.0	+4.8	-2.2	+2.5	-8.0	+12.1	-4.5	+5.6
Fully correlated ( $\gamma = 1$ )	-6.3	+9.9	-3.7	+4.9	-12.6	+26.7	-7.6	+11.4
Correlation ( $\gamma = 0.9$ )	-6.0	+9.0	-3.5	+4.5	-12.0	+23.9	-7.2	+10.5
Species mainly removed in the troposphere								
CH <sub>3</sub> CCl <sub>3</sub>	0.0	0.0			0.0	0.0		
HCFC-22	-0.4	+0.8			-0.2	+0.7		
HCFC-141b	-0.4	+0.7			-0.3	+0.7		
HCFC-142b	-0.1	+0.1			-0.1	+0.2		
Halon-1211	-2.0	+5.4			-0.9	+5.0		
Halon-1202	0.0	0.0			0.0	0.0		
Halon-2402	-0.4	+0.5			-0.4	+0.7		
CH <sub>3</sub> Br	-1.1	+2.4			-1.5	+3.0		
All of this group combined <sup>b</sup>								
Uncorrelated ( $\gamma = 0$ )	-2.9	+5.8			-2.4	+5.6		
Fully correlated ( $\gamma = 1$ )	-4.6	+10.1			-3.5	+10.0		
Correlation ( $\gamma = 0.9$ )	-4.4	+9.3			-3.4	+9.2		
All ODSs combined <sup>b</sup>								
Uncorrelated ( $\gamma = 0$ )	-5.2	+7.7	-3.8	+6.3	-8.9	+13.5	-5.5	+7.8
Fully correlated ( $\gamma = 1$ )	-8.3	+14.6	-6.2	+11.2	-14.1	+28.4	-9.3	+14.6
Correlation ( $\gamma = 0.9$ )	-7.9	+13.4	-5.9	+10.5	-13.4	+25.7	-8.8	+13.5

a) A year is only given for those ODSs that have a most likely range in lifetime that differs from the possible range (see Table 1).

b) A correlation coefficient  $\gamma$  is applied to the uncertainty in the loss rates of species removed mainly in the stratosphere or troposphere (Table 2).

Table S2. Effect of uncertainties on the year EESC returns to pre 1980-levels for mid-latitude and Antarctic conditions (given in years) and the change in integrated EESC above the 1980 level (given as percentage changes). Shown are the median and uncertainty ranges (95% confidence interval) as difference from the median. Also, shown for comparison, are cases of zero production and zero emission starting in 2014.

	Mid-latitude conditions		Antarctic conditions		Integrated EESC mid-latitude conditions	
Base run model (median)	2048		2075			
Production up to 2008	-0.5	+0.5	-0.6	+0.6	-1%	+1%
Bank sizes of 2008	-1.5	+1.3	-2.2	+2.0	-2%	+2%
Emission factors	-0.8	+0.5	-0.5	+0.5	-2%	+1%
Lifetimes (possible range) <sup>a</sup>	-7.9	+13.4	-13.4	+25.7	-9%	+16%
Lifetimes (most likely range) <sup>a</sup>	-5.9	+10.5	-8.8	+13.5	-8%	+14%
Fractional releases	-2.9	+3.0	-3.0	+3.5	-10%	+11% <sup>b</sup>
Factor $\alpha$ (Br efficiency)	-2.8	+2.4	-3.1	+2.8	-7%	+6% <sup>b</sup>
Mean age-of-air	-4.6	+5.1	-7.9	+7.5	-15%	+18% <sup>b</sup>
Surface factor ( $F_{surf}$ )	-1.1	+1.1	-1.4	+1.4	-2%	+2%
Observed mixing ratios	-0.4	+0.5	-0.3	+0.4	-1%	+1%
All of above combined						
Possible lifetime range <sup>a</sup>	-9.8	+15.8	-16.1	+28.3	-21%	+29% <sup>b</sup>
Most likely lifetime range <sup>a</sup>	-8.6	+12.7	-12.8	+16.9	-21%	+28% <sup>b</sup>
Zero production 2014 onward	-3.1		-2.7		-5%	
Zero emissions 2014 onward	-11.6		-12.5		-13%	

a) Correlation coefficient  $\gamma$  of 0.9 is applied.

b) Calculated using the normalized EESC.

## Contents of output files

The two files named ‘All\_parameters\_SPARC2013\_possible\_mc.dat’ and ‘All\_parameters\_SPARC2013\_mostlikely\_mc.dat’ contain all the output data of the uncertainty analysis for 1950 to 2020:

- production, banks, emissions ( $\text{t yr}^{-1}$ ) and mixing ratios (ppt) of all ODSs,
- normalized EESC for mid-latitudes and Antarctic conditions (1980 value set to 1),
- radiative forcing in  $\text{mW m}^{-2}$ ,
- ODP-weighted emissions in  $\text{tCFC-11-eq yr}^{-1}$ ,
- GWP-weighted emissions in  $\text{tCO}_2\text{-eq yr}^{-1}$ ,
- years EESC returns to pre-1980 levels for mid-latitude and Antarctic conditions.

For all the quantities the mean values, standard deviations, and 2.5-, 50- and 97.5-percentiles are given calculated with a Monte Carlo run with an ensemble size of 250 000. The data is generated using the lifetimes from SPARC (2013) with the possible and most likely uncertainty ranges, as well as uncertainties applied to all other parameters. The data in these files are used for Figures 6, 8, 9, 10, and S1.

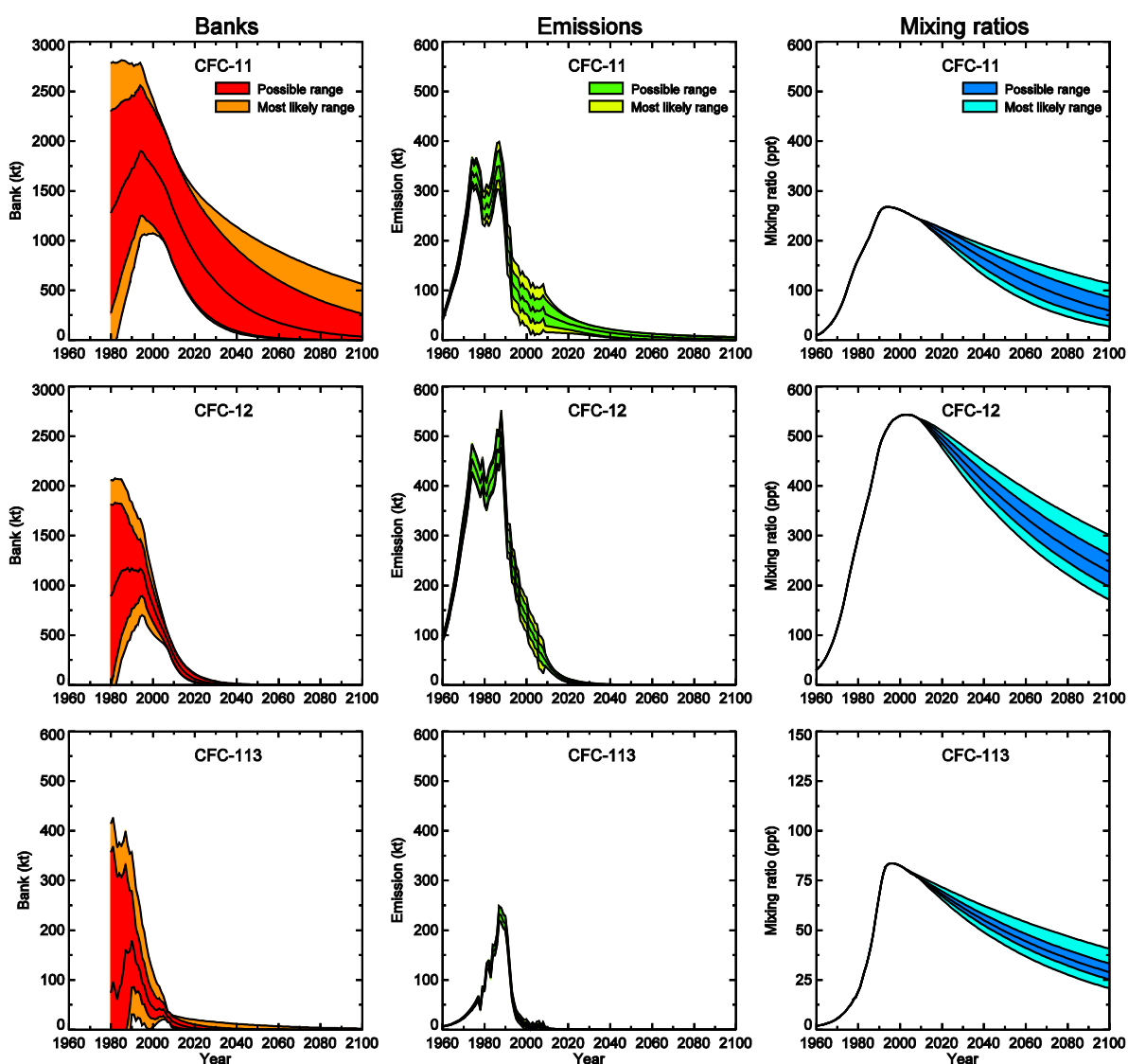


Figure S1. Banks, emissions, and mixing ratios of ODSs from 1960 to 2100 with uncertainties applied to all parameters. Shown are the median values and 95% confidence interval based on the possible (light colors) and most likely (dark colors) uncertainty ranges in lifetimes.

Figure S1. continued

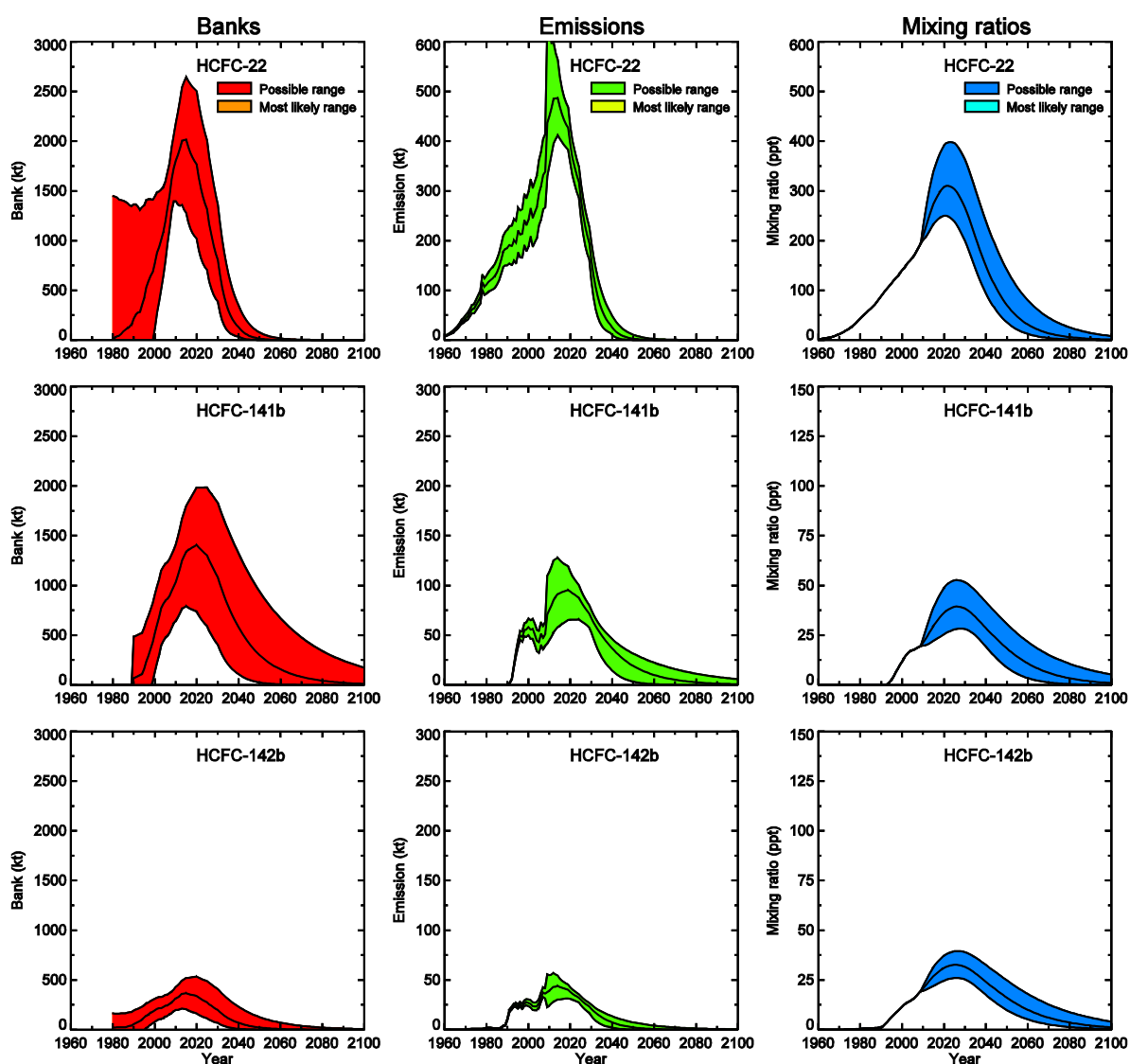


Figure S1 continued

