Supplement of Atmos. Chem. Phys., 24, 13457–13475, 2024
https://doi.org/10.5194/acp-24-13457-2024-supplement

Atmospheric Chemistry and Physics
Open Access

Supplement of

On the atmospheric budget of 1,2-dichloroethane and its impact on stratospheric chlorine and ozone (2002–2020)

Ryan Hossaini et al.

Correspondence to: Ryan Hossaini (r.hossaini@lancaster.ac.uk)

Table S1. Summary statistics (mean and median) of observed and modelled DCE at Bachok and Taiwan. Model data is shown for the scenario sc05 (α_1 = 0.5/1.5%).

Site	Year	Sampling months	# obs.	Measured DCE (ppt)		Modelled DCE (ppt)	
				Mean (±1 s.d)	Median	Mean (±1 s.d)	Median
Bachok	2014	Jan/Feb	16	46.2 (±28)	50.7	34.1 (±13.0)	32.4
Bachok	2015	Nov/Dec	24	24.9 (±20)	16.1	14.3 (±7.0)	11.6
Bachok	2016	Jan	17	20.9 (±15)	14.0	12.2 (±5.3)	10.2
Bachok	2017	Jan/Feb/Mar/Apr	41	18.8 (±10)	16.8	24.8 (±12.9)	22.1
Bachok	2018	Dec	2	25.6 (±14)	35.5	6.4 (±7.2)	11.5
Bachok	2019	Jan/Feb	26	44.4 (±48)	28.7	25.0 (±16.0)	19.8
Bachok	2020	Dec/Jan/Feb	17	44.2 (±41)	33.5	29.7 (±17.0)	26.3
Taiwan	2014	Mar/Apr	24	137.5 (±190)	82.8	120.5 (±12.7)	121.0
Taiwan	2015	Mar/Apr	23	84.3 (±83)	59.0	131.4 (±20.8)	128.5
Taiwan	2016	Mar/Apr	0	-	-	125.1 (±19.5)	121.4
Taiwan	2017	Apr/May	31	83.5 (±69)	58.4	131.2 (±21.6)	128.5
Taiwan	2018	Apr/May/Jun	28	146.7 (±137)	103.2	154.9 (±21.5)	149.4
Taiwan	2019	Mar/May	52	143.5 (±127)	116.9	140.2 (±19.5)	139.2
Taiwan	2020	Apr/May	40	102.0 (±85)	63.1	136.3 (±15.8)	141.8

Table S2. Observed and modelled DCE abundance (ppt) averaged in 1 km altitude bins during KORUS-AQ. n denotes the number of measurements in each bin. Median DCE is reported with values in square brackets denoting the 25th and 75th percentile. The mean bias (MB, model minus observation) is given for each bin. Model results are based on scenario sc05 (α_1 = 0.5/1.5%).

Altitude bin centre (km)	**KORUS-AQ campaign**			
	n	***Observed DCE (ppt)***	***Modelled DCE (ppt)***	***MB (ppt)***
0.5	1323	68.9 [33.9, 126.6]	52.7 [38.7, 71.2]	-16.2
1.5	573	37.2 [22.5, 73.9]	45.4 [33.8, 57.7]	8.2
2.5	256	22.0 [17.5, 36.4]	27.7 [20.8, 44.1]	5.7
3.5	155	18.1 [15.7, 23.7]	16.6 [15.4, 18.8]	-1.5
4.5	119	16.0 [14.2, 18.8]	15.9 [14.8, 17.0]	-0.1
5.5	94	15.1 [14.0, 18.3]	15.5 [14.6, 16.4]	0.4
6.5	104	15.1 [13.5, 16.7]	15.4 [13.9, 17.3]	0.3
7.5	160	14.7 [12.9, 18.2]	14.6 [13.4, 15.7]	-0.1

Table S3. Comparison of DCE emission estimates (Gg/yr) for parts of East Asia from this work (scenario sc05) and previous studies.

Study	**Region**	**Emission estimate (Gg/yr)**	**For year**	**Method**
Wang et al. (2014)	China	121.6 (±89)	2010	Tracer ratio
Oram et al. (2017)	China	203 (±9)	2015	Tracer ratio
This work, α_1=0.5/1.5%	China+Taiwan	89 (73-106)	2010	Bottom-up (see main text Sect. 2)
This work. α_1=0.5/1.5%	China+Taiwan	107 (87-127)	2015	Bottom-up (see main text Sect. 2)

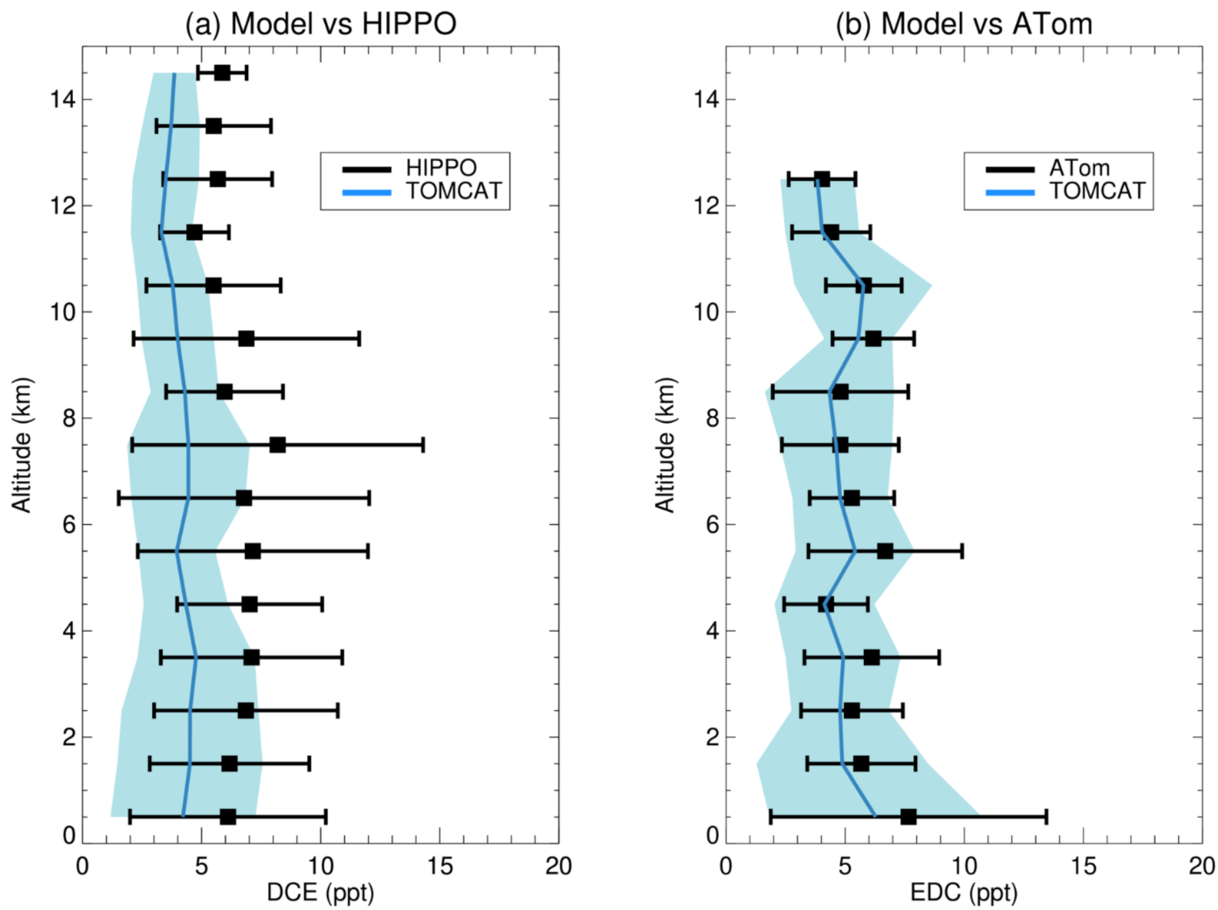

Figure S1. Tropical (±20 °N/S) mean DCE profiles (ppt) observed during (a) HIPPO and (b) ATom averaged in 1 km altitude bins (±1.s.d). The corresponding model profiles are shown for emission scenario sc05.

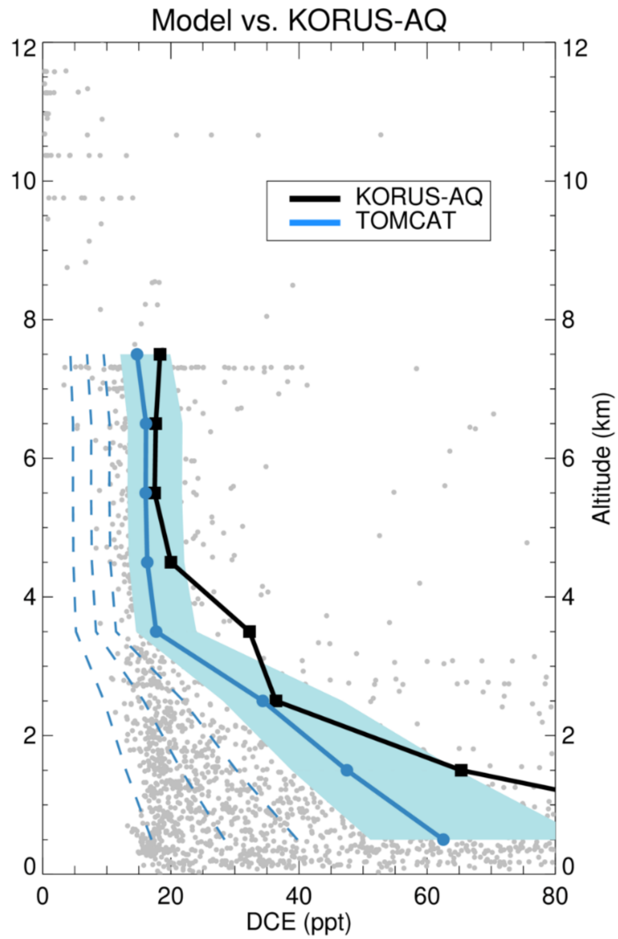

Figure S2. As Figure 3 (panel c) of the main manuscript but comparing the mean KORUS-AQ measurement data with the mean model data (as opposed to the median) in different altitude bins.

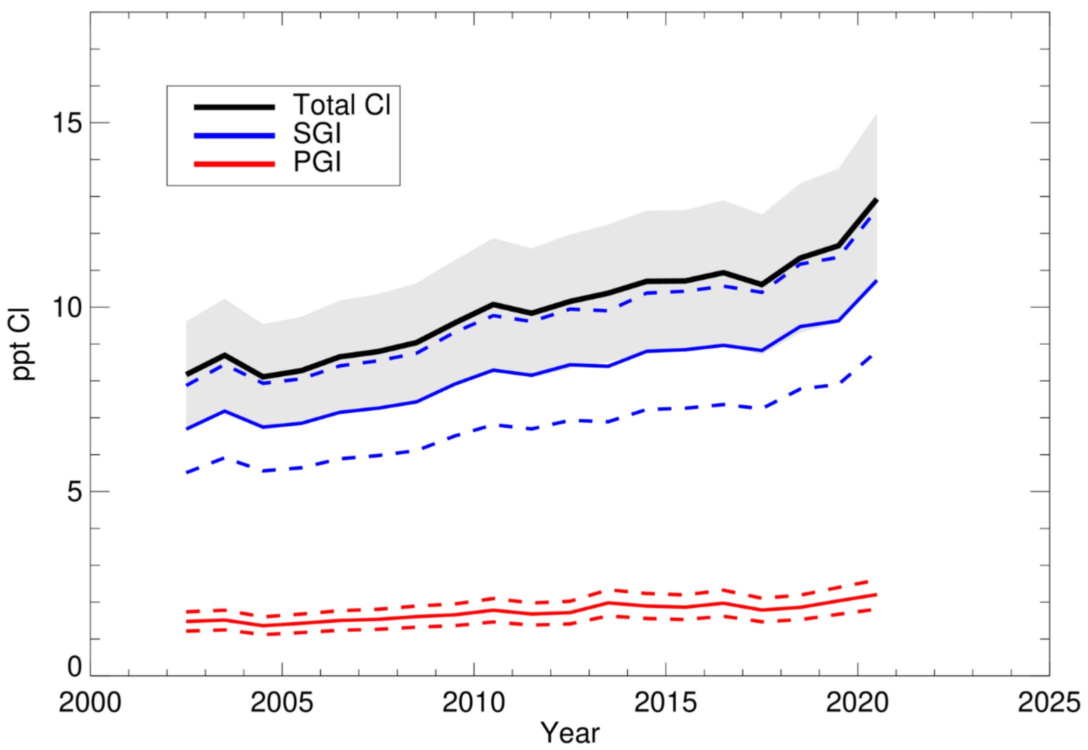

Figure S3. Modelled annual mean stratospheric chlorine SGI, PGI and total (SGI + PGI) due to DCE (ppt Cl) diagnosed at the tropical tropopause. Solid lines represent results from emission scenario sc05 with shading or dotted lines denoting the range from scenarios sc04 and sc06.

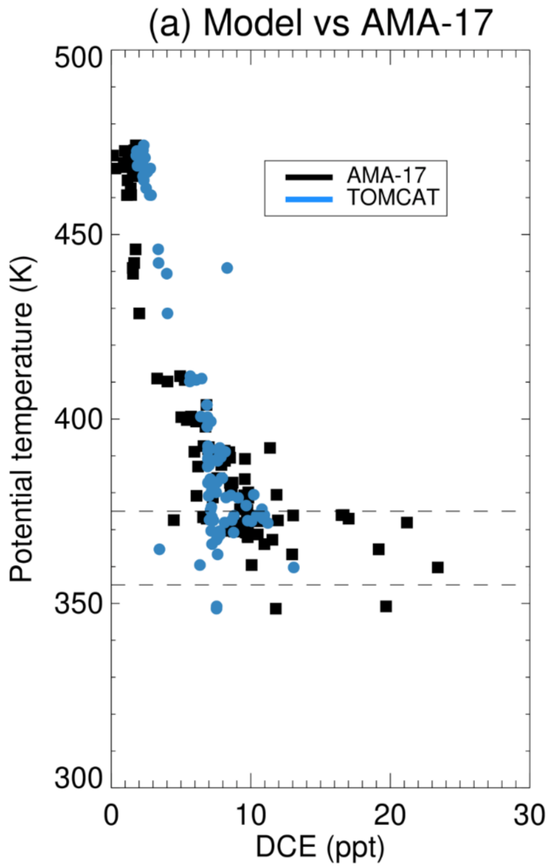

Figure S4. DCE mole fraction (ppt) vs potential temperature observed during the AMA-17 campaign (Adcock et al., 2021) and corresponding model estimates for emission scenario sc05. The horizontal dashed lines denote the tropopause region (355-375 K).

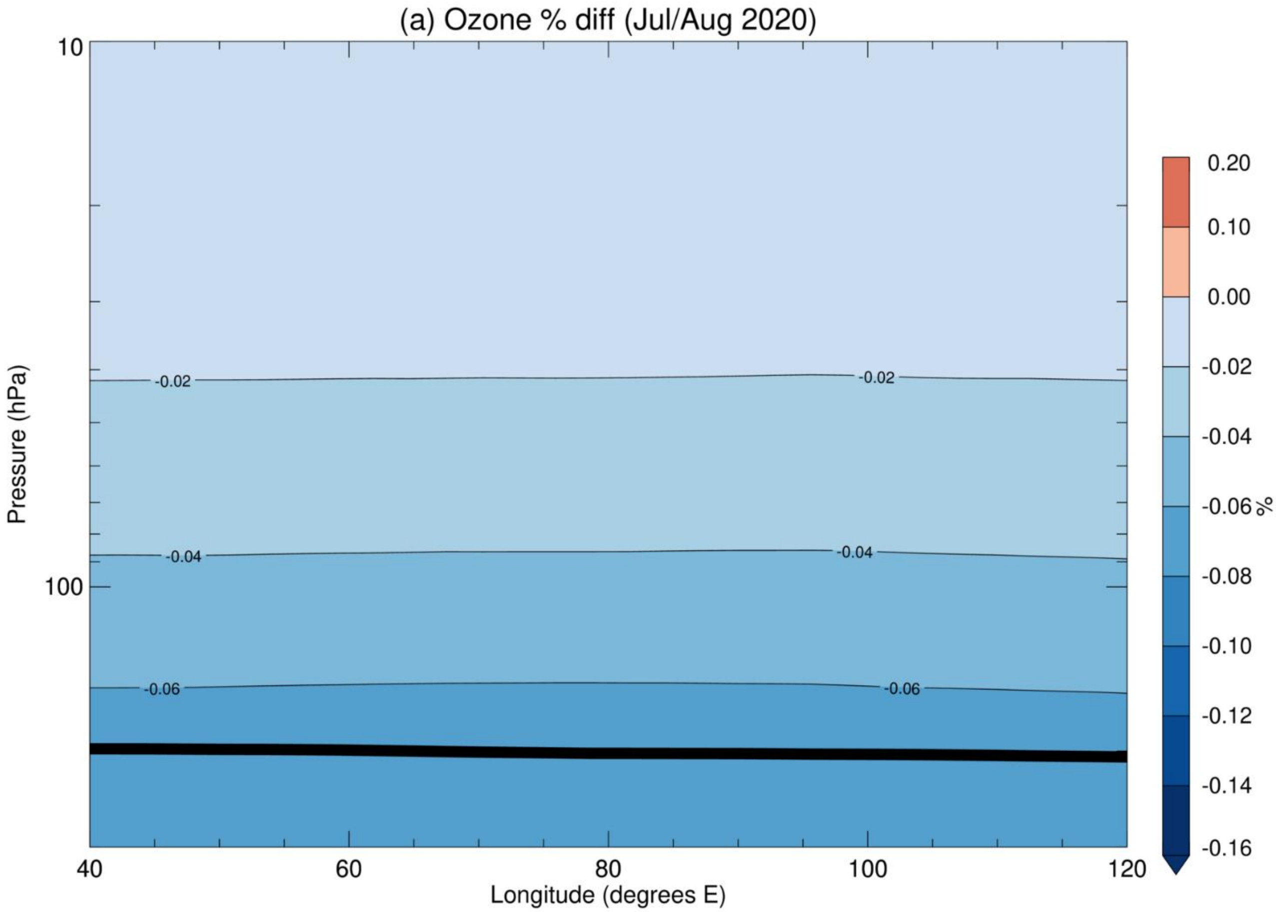

Figure S5. Longitude–pressure cross section of the modelled stratospheric ozone decrease (%) due to DCE in 2020. The change is averaged over July/August and over the approximate latitude range of the Asian Summer Monsoon anticyclone (20-40° N latitude). The ozone change is calculated as the difference between a simulation with DCE (scenario sc05) and without DCE.