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Supplement of

Influence of total ozone column (TOC) on the occurrence of tropospheric ozone depletion events (ODEs) in the Antarctic

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Table S1. Correlation coefficients between the daily TOCs belonging to different stations in the Antarctic.

Year	2007	2008	2009	2010	2011	2012	2013
Halley vs. Belgrano II	0.92	0.85	0.92	0.82	0.92	0.96	0.99
Faraday-Vernadsky vs. Marambio	0.94	0.91	0.95	0.95	0.89	0.92	0.96
Halley vs. Faraday-Vernadsky	0.62	0.35	0.13	0.39	0.41	0.47	0.72

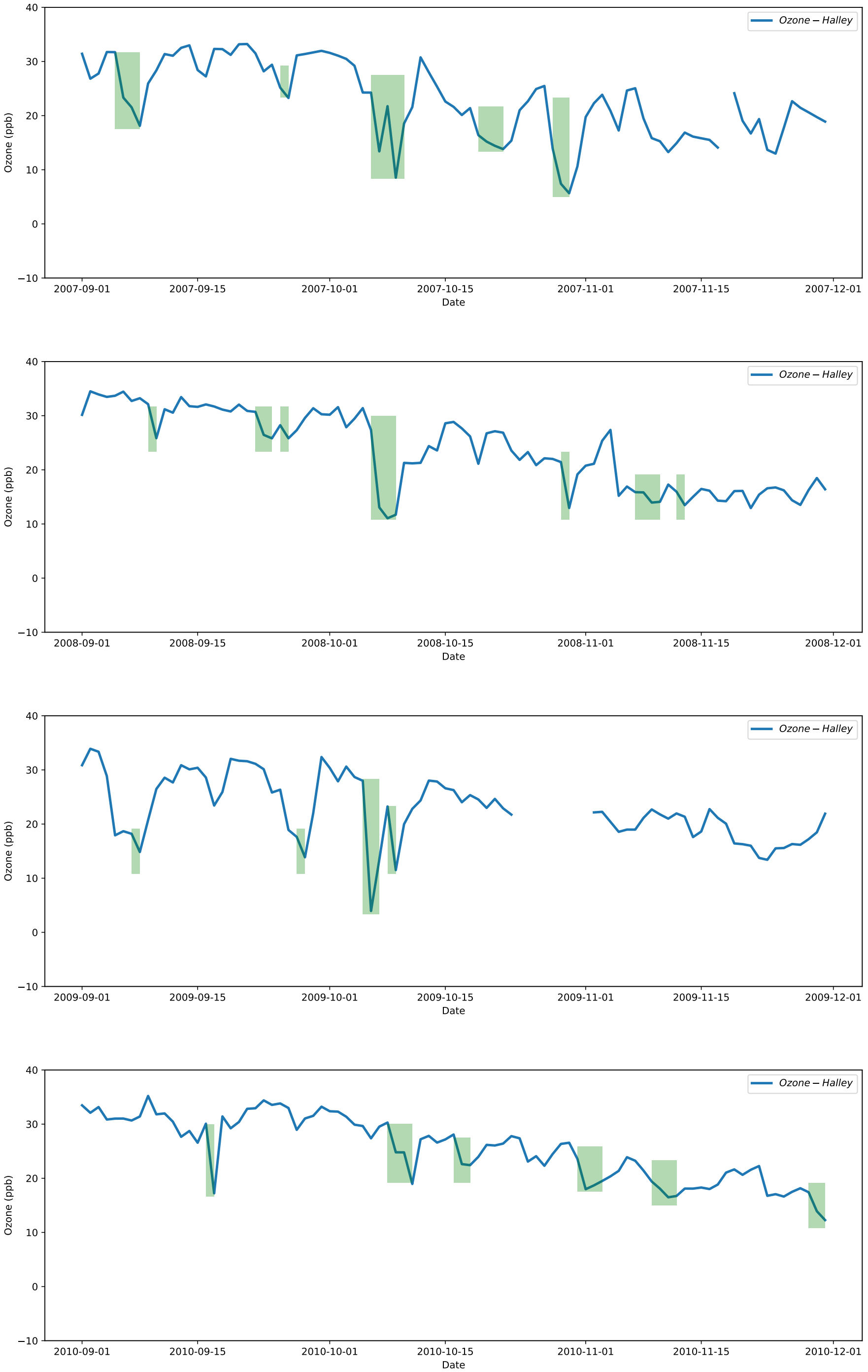

Figure S1. (Continued...)

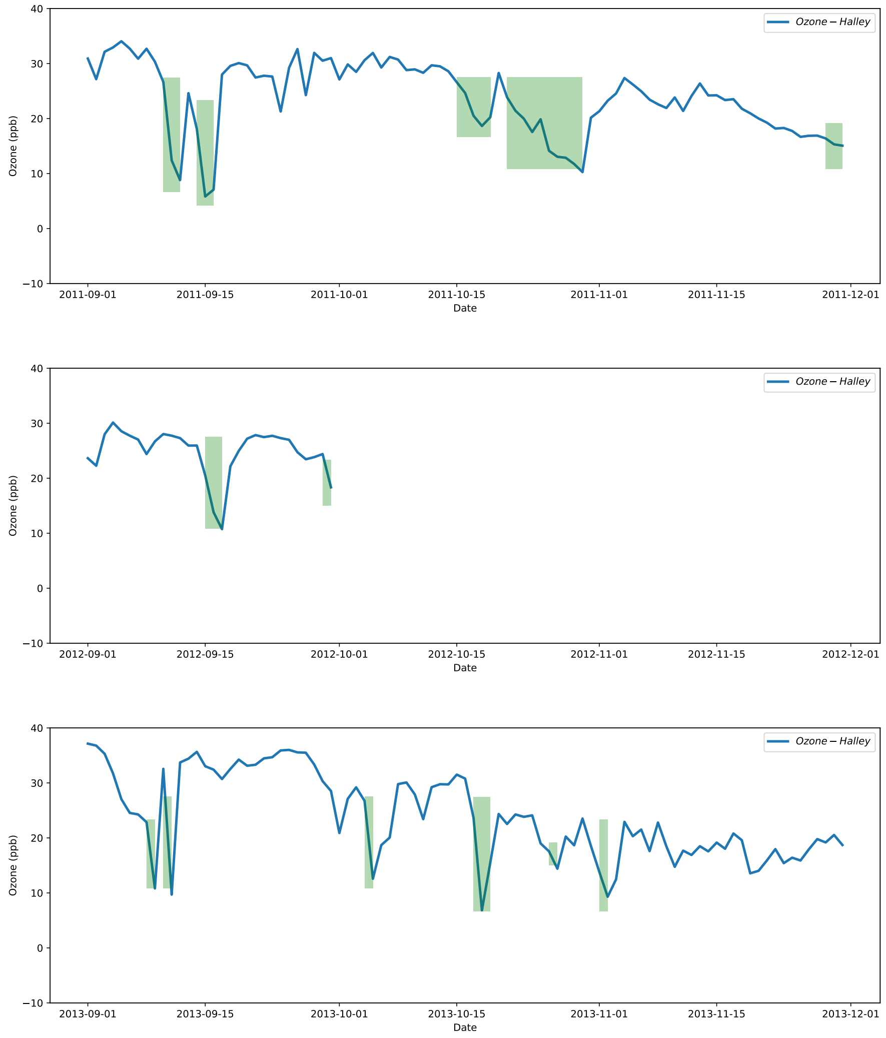

Figure S1. Time series of the surface ozone detected at the Halley station during the springtime of years 2007-2013. The green-shaded areas in the figure indicate the periods identified as the occurrence of ODEs in the present study. Note that the observational data of the surface ozone for October and November in the year 2012 are missing.

Table S2. Input parameters of the TUV model.

Parameter	Option	Value	Unit
Wavelength	Start	280	nm
	End	420	nm
	Increments	140	
Latitude		-65.25	degrees
Longitude		-64.27	degrees
Date		vary with time	
Time		12 PM	
TOC		vary with time	DU
Surface albedo		0.85	
Ground elevation		0.01	km
Measurement altitude		0.21	km
Clouds	Optical depth	0.00	km
	Base	4.00	km
	Top	5.00	km
Aerosols	Optical depth	0.235	km
	Single scattering albedo	0.990	
	Angstrom exponent	1.000	
Sunlight	Direct beam	1.0	
	Diffuse down	1.0	
	Diffuse up	1.0	

Table S3. The complete chemical reaction mechanism with an implementation of a constant temperature $T = 258\,\mathrm{K}$, and the rate of third-body reactions is estimated as $k = k_\infty \times \frac{k_0/k_\infty}{(1+k_0/k_\infty)} \times F_c^{\frac{1}{1+(\log_{10}(k_0/k_\infty))^2}}$ (Atkinson et al., 2006).

Reaction Number	Reaction	k $[(\mathrm{molec.\ cm^{-3}})^{1-n}\mathrm{s^{-1}}]$	Order n	Reference
(SR1)	$O_3 + h\nu \rightarrow O(^1D) + O_2$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR2)	$O(^1D) + O_2 \rightarrow O_3$	$3.20 \times 10^{-11}\exp(67/T)$	2	Atkinson et al. (2006)
(SR3)	$O(^1D) + N_2 \rightarrow O_3 + N_2$	$1.80 \times 10^{-11}\exp(107/T)$	2	Atkinson et al. (2006)
(SR4)	$O(^1D) + H_2O \rightarrow 2OH$	2.20×10^{-10}	2	Atkinson et al. (2006)
(SR5)	$Br + O_3 \rightarrow BrO + O_2$	$1.70 \times 10^{-11}\exp(-800/T)$	2	Atkinson et al. (2006)
(SR6)	$Br_2 + h\nu \rightarrow 2Br$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR7)	$BrO + h\nu \xrightarrow{O_2} Br + O_3$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR8)	$BrO + BrO \rightarrow 2Br + O_2$	2.70×10^{-12}	2	Atkinson et al. (2006)
(SR9)	$BrO + BrO \rightarrow Br_2 + O_2$	$2.90 \times 10^{-14}\exp(840/T)$	2	Atkinson et al. (2006)
(SR10)	$BrO + HO_2 \rightarrow HOBr + O_2$	$4.5 \times 10^{-12}\exp(500/T)$	2	Atkinson et al. (2006)
(SR11)	$HOBr + h\nu \rightarrow Br + OH$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR12)	$CO + OH(+M) \xrightarrow{O_2} HO_2 + CO_2(+M)$	$1.44 \times 10^{-13}(1 + \frac{[N_2]}{4\times10^{19}})$	2	Atkinson et al. (2006)
(SR13)	$Br + HO_2 \rightarrow HBr + O_2$	$7.70 \times 10^{-12}\exp(-450/T)$	2	Atkinson et al. (2006)
(SR14)	$HOBr + HBr \xrightarrow{\mathrm{aerosol}} Br_2 + H_2O$	$(\frac{r}{D_g} + \frac{4}{v_{\mathrm{therm}}\gamma})^{-1}\alpha_{\mathrm{eff,aerosol}}$		Cao et al. (2014)
(SR15)	$HOBr + H^+ + Br^- \xrightarrow{\mathrm{ice}} Br_2 + H_2O$	$(r_a + r_b + r_c)^{-1}\alpha_{\mathrm{eff,ice}}$		Cao et al. (2014)
(SR16)	$Br + HCHO \xrightarrow{O_2} HBr + CO + HO_2$	$7.70 \times 10^{-12}\exp(-580/T)$	2	Atkinson et al. (2006)
(SR17)	$Br + CH_3CHO \xrightarrow{O_2} HBr + CH_3CO_3$	$1.80 \times 10^{-11}\exp(-460/T)$	2	Atkinson et al. (2006)
(SR18)	$Br_2 + OH \rightarrow HOBr + Br$	$2.0 \times 10^{-11}\exp(240/T)$	2	Atkinson et al. (2006)
(SR19)	$HBr + OH \rightarrow H_2O + Br$	$5.50 \times 10^{-12}\exp(205/T)$	2	Atkinson et al. (2006)
(SR20)	$Br + C_2H_2 \xrightarrow{3O_2} 2CO + 2HO_2 + Br$	4.20×10^{-14}	2	Borken (1996)
(SR21)	$Br + C_2H_2 \xrightarrow{2O_2} 2CO + HO_2 + HBr$	8.92×10^{-14}	2	Borken (1996)
(SR22)	$Br + C_2H_4 \xrightarrow{3.5O_2} 2CO + 2HO_2 + Br + H_2O$	2.52×10^{-13}	2	Barnes et al. (1993)
(SR23)	$Br + C_2H_4 \xrightarrow{2.5O_2} 2CO + HO_2 + HBr + H_2O$	5.34×10^{-13}	2	Barnes et al. (1993)
(SR24)	$CH_4 + OH \xrightarrow{O_2} CH_3O_2 + H_2O$	$1.85 \times 10^{-12}\exp(-1690/T)$	2	Atkinson et al. (2006)
(SR25)	$BrO + CH_3O_2 \rightarrow Br + HCHO + HO_2$	1.60×10^{-12}	2	Aranda et al. (1997)
(SR26)	$BrO + CH_3O_2 \rightarrow HOBr + HCHO + 0.5O_2$	4.10×10^{-12}	2	Aranda et al. (1997)
(SR27)	$OH + O_3 \rightarrow HO_2 + O_2$	$1.70 \times 10^{-12}\exp(-940/T)$	2	Atkinson et al. (2006)
(SR28)	$OH + HO_2 \rightarrow H_2O + O_2$	$4.80 \times 10^{-11}\exp(250/T)$	2	Atkinson et al. (2006)
(SR29)	$OH + H_2O_2 \rightarrow HO_2 + H_2O$	$2.90 \times 10^{-12}\exp(-160/T)$	2	Atkinson et al. (2006)
(SR30)	$OH + OH \xrightarrow{O_2} H_2O + O_3$	$6.20 \times 10^{-14}(T/298)^{2.6}\exp(945/T)$	2	Atkinson et al. (2006)
(SR31)	$HO_2 + O_3 \rightarrow OH + 2O_2$	$2.03 \times 10^{-16}(T/300)^{4.57}\exp(693/T)$	2	Atkinson et al. (2006)
(SR32)	$HO_2 + HO_2 \rightarrow O_2 + H_2O_2$	$2.20 \times 10^{-13}\exp(600/T)$	2	Atkinson et al. (2006)
(SR33)	$C_2H_6 + OH \rightarrow C_2H_5 + H_2O$	$6.90 \times 10^{-12}\exp(-1000/T)$	2	Atkinson et al. (2006)
(SR34)	$C_2H_5 + O_2 \rightarrow C_2H_4 + HO_2$	3.80×10^{-15}	2	Atkinson et al. (2006)

Table S3. (continued).

Reaction Number	Reaction	k $[(\text{molec. cm}^{-3})^{1-n}\text{s}^{-1}]$	Order n	Reference
(SR35)	$C_2H_5 + O_2(+M) \rightarrow C_2H_5O_2(+M)$	$k_0 = 5.90 \times 10^{-29}(T/300)^{-3.8}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 7.80 \times 10^{-12}$		
		$F_c = 0.58\exp(-T/1250)$		
		$+0.42\exp(-T/183)$		
(SR36)	$C_2H_4 + OH(+M) \xrightarrow{1.5O_2} CH_3O_2 + CO + H_2O(+M)$	$k_0 = 8.60 \times 10^{-29}(T/300)^{-3.1}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 9.00 \times 10^{-12}(T/300)^{-0.85}$		
		$F_c = 0.48$		
(SR37)	$C_2H_4 + O_3 \rightarrow HCHO + CO + H_2O$	4.33×10^{-19}	2	Sander et al. (1997)
(SR38)	$C_2H_2 + OH(+M) \xrightarrow{1.5O_2} HCHO + CO + HO_2(+M)$	$k_0 = 5.00 \times 10^{-30}(T/300)^{-1.5}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 1.00 \times 10^{-12}$		
		$F_c = 0.37$		
(SR39)	$C_3H_8 + OH \xrightarrow{2O_2} C_2H_5O_2 + CO + 2H_2O$	$7.60 \times 10^{-12}\exp(-585/T)$	2	Atkinson et al. (2006)
(SR40)	$HCHO + OH \xrightarrow{O_2} CO + H_2O + HO_2$	$5.40 \times 10^{-12}\exp(135/T)$	2	Atkinson et al. (2006)
(SR41)	$CH_3CHO + OH \xrightarrow{O_2} CH_3CO_3 + H_2O$	$4.40 \times 10^{-12}\exp(365/T)$	2	Atkinson et al. (2006)
(SR42)	$CH_3O_2 + HO_2 \rightarrow CH_3O_2H + O_2$	$3.42 \times 10^{-13}\exp(780/T)$	2	Atkinson et al. (2006)
(SR43)	$CH_3O_2 + HO_2 \rightarrow HCHO + H_2O + O_2$	$3.79 \times 10^{-14}\exp(780/T)$	2	Atkinson et al. (2006)
(SR44)	$CH_3OOH + OH \rightarrow CH_3O_2 + H_2O$	$1.00 \times 10^{-12}\exp(190/T)$	2	Atkinson et al. (2006)
(SR45)	$CH_3OOH + OH \rightarrow HCHO + OH + H_2O$	$1.90 \times 10^{-12}\exp(190/T)$	2	Atkinson et al. (2006)
(SR46)	$CH_3OOH + Br \rightarrow CH_3O_2 + HBr$	$2.66 \times 10^{-12}\exp(-1610/T)$	2	Mallard et al. (1993)
(SR47)	$CH_3O_2 + CH_3O_2 \rightarrow CH_3OH + HCHO + O_2$	$6.29 \times 10^{-14}\exp(365/T)$	2	Atkinson et al. (2006)
(SR48)	$CH_3O_2 + CH_3O_2 \xrightarrow{O_2} 2HCHO + 2HO_2$	$3.71 \times 10^{-14}\exp(365/T)$	2	Atkinson et al. (2006)
(SR49)	$CH_3OH + OH \xrightarrow{O_2} HCHO + HO_2 + H_2O$	$2.42 \times 10^{-12}\exp(-345/T)$	2	Atkinson et al. (2006)
(SR50)	$C_2H_5O_2 + C_2H_5O_2 \rightarrow C_2H_5O + C_2H_5O + O_2$	6.40×10^{-14}	2	Atkinson et al. (2006)
(SR51)	$C_2H_5O + O_2 \rightarrow CH_3CHO + HO_2$	7.44×10^{-15}	2	Sander et al. (1997)
(SR52)	$C_2H_5O + O_2 \rightarrow CH_3O_2 + HCHO$	7.51×10^{-17}	2	Sander et al. (1997)
(SR53)	$C_2H_5O_2 + HO_2 \rightarrow C_2H_5OOH + O_2$	$3.80 \times 10^{-13}\exp(900/T)$	2	Atkinson et al. (2006)
(SR54)	$C_2H_5OOH + OH \rightarrow C_2H_5O_2 + H_2O$	8.21×10^{-12}	2	Sander et al. (1997)
(SR55)	$C_2H_5OOH + Br \rightarrow C_2H_5O_2 + HBr$	5.19×10^{-15}	2	Sander et al. (1997)
(SR56)	$OH + OH(+M) \longrightarrow H_2O_2(+M)$	$k_0 = 6.90 \times 10^{-31}(T/300)^{-0.8}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 2.60 \times 10^{-11}$		
		$F_c = 0.50$		
(SR57)	$H_2O_2 + h\nu \rightarrow 2OH$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR58)	$HCHO + h\nu \xrightarrow{2O_2} 2HO_2 + CO$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR59)	$HCHO + h\nu \rightarrow H_2 + CO$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR60)	$C_2H_4O + h\nu \rightarrow CH_3O_2 + CO + +HO_2$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)

Table S3. (continued).

Reaction Number	Reaction	k $[(\text{molec. cm}^{-3})^{1-n}\text{s}^{-1}]$	Order n	Reference
(SR61)	$CH_3O_2H + h\nu \rightarrow OH + HCHO + HO_2$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR62)	$C_2H_5O_2H + h\nu \rightarrow C_2H_5O + OH$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR63)	$NO + O_3 \rightarrow NO_2 + O_2$	$1.40 \times 10^{-12}\exp(-1310/T)$	2	Atkinson et al. (2006)
(SR64)	$NO + HO_2 \rightarrow NO_2 + OH$	$3.60 \times 10^{-12}\exp(270/T)$	2	Atkinson et al. (2006)
(SR65)	$NO_2 + O_3 \rightarrow NO_3 + O_2$	$1.40 \times 10^{-13}\exp(-2470/T)$	2	Atkinson et al. (2006)
(SR66)	$NO_2 + OH(+M) \rightarrow HNO_3(+M)$	$k_0 = 3.30 \times 10^{-30}(T/300)^{-3.0}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 4.10 \times 10^{-11}$		
		$F_c = 0.40$		
(SR67)	$NO + NO_3 \rightarrow 2NO_2$	$1.80 \times 10^{-11}\exp(110/T)$	2	Atkinson et al. (2006)
(SR68)	$HONO + OH \rightarrow NO_2 + H_2O$	$2.50 \times 10^{-12}\exp(260/T)$	2	Atkinson et al. (2006)
(SR69)	$HO_2 + NO_2(+M) \rightarrow HNO_4(+M)$	$k_0 = 1.80 \times 10^{-31}(T/300)^{-3.2}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 4.70 \times 10^{-12}$		
		$F_c = 0.60$		
(SR70)	$HNO_4(+M) \rightarrow NO_2 + HO_2(+M)$	$k_0 = 4.10 \times 10^{-5}\exp(-10650/T)[N_2]$	1	Atkinson et al. (2006)
		$k_\infty = 4.80 \times 10^{15}\exp(-11170/T)$		
		$F_c = 0.60$		
(SR71)	$HNO_4 + OH \rightarrow NO_2 + H_2O + O_2$	$3.20 \times 10^{-13}\exp(690/T)$	2	Atkinson et al. (2006)
(SR72)	$NO + OH(+M) \rightarrow HONO(+M)$	$k_0 = 7.40 \times 10^{-31}(T/300)^{-2.4}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 3.30 \times 10^{-11}(T/300)^{-0.3}$		
		$F_c = 0.81$		
(SR73)	$OH + NO_3 \rightarrow NO_2 + HO_2$	2.00×10^{-11}	2	Atkinson et al. (2006)
(SR74)	$HNO_3 + h\nu \rightarrow NO_2 + OH$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR75)	$NO_2 + h\nu \xrightarrow{O_2} NO + O_3$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR76)	$NO_3 + h\nu \xrightarrow{O_2} NO_2 + O_3$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR77)	$NO_3 + h\nu \rightarrow NO + O_2$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR78)	$NO + CH_3O_2 \xrightarrow{O_2} HCHO + HO_2 + NO_2$	$2.30 \times 10^{-12}\exp(360/T)$	2	Atkinson et al. (2006)
(SR79)	$NO_3 + CH_3OH \xrightarrow{O_2} HCHO + HO_2 + HNO_3$	$9.40 \times 10^{-13}\exp(-2650/T)$	2	Atkinson et al. (2006)
(SR80)	$NO_3 + HCHO \xrightarrow{O_2} CO + HO_2 + HNO_3$	5.60×10^{-16}	2	Atkinson et al. (2006)
(SR81)	$NO + C_2H_5O_2 \xrightarrow{O_2} CH_3CHO + NO_2 + HO_2$	$2.60 \times 10^{-12}\exp(380/T)$	2	Atkinson et al. (2006)
(SR82)	$NO + CH_3CO_3 \xrightarrow{O_2} CH_3O_2 + NO_2 + CO_2$	$7.50 \times 10^{-12}\exp(290/T)$	2	Atkinson et al. (2006)
(SR83)	$NO_2 + CH_3CO_3(+M) \rightarrow PAN(+M)$	$k_0 = 2.70 \times 10^{-28}(T/300)^{-7.1}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 1.20 \times 10^{-11}(T/300)^{-0.9}$		
		$F_c = 0.30$		
(SR84)	$Br + NO_2(+M) \rightarrow BrNO_2(+M)$	$k_0 = 4.20 \times 10^{-31}(T/300)^{-2.4}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 2.70 \times 10^{-11}$		
		$F_c = 0.55$		
(SR85)	$Br + NO_3 \rightarrow BrO + NO_2$	1.60×10^{-11}	2	Atkinson et al. (2006)

Table S3. (continued).

Reaction Number	Reaction	k $[(\text{molec. cm}^{-3})^{1-n}\text{s}^{-1}]$	Order n	Reference
(SR86)	$BrO + NO_2(+M) \rightarrow BrONO_2(+M)$	$k_0 = 4.70 \times 10^{-31}(T/300)^{-3.1}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 1.80 \times 10^{-11}$		
		$F_c = 0.40$		
(SR87)	$BrO + NO \rightarrow Br + NO_2$	$8.70 \times 10^{-12}\exp(260/T)$	2	Atkinson et al. (2006)
(SR88)	$BrONO_2 + h\nu \rightarrow NO_2 + BrO$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR89)	$BrNO_2 + h\nu \rightarrow NO_2 + Br$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR90)	$BrONO_2 + H_2O \xrightarrow{\text{aerosol}} HOBr + HNO_3$	$(\frac{r}{D_g} + \frac{4}{v_{\text{therm}}\gamma})^{-1}\alpha_{\text{eff,aerosol}}$		Cao et al. (2014)
(SR91)	$PAN + h\nu \rightarrow NO_2 + CH_3CO_3$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR92)	$BrONO_2 + H_2O \xrightarrow{\text{ice}} HOBr + HNO_3$	$(r_a + r_b + r_c)^{-1}\alpha_{\text{eff,ice}}$		Cao et al. (2014)
(SR93)	$CH_3O_2H + Cl \rightarrow CH_3O_2 + HCl$	5.90×10^{-11}	2	Atkinson et al. (2006)
(SR94)	$C_2H_5O_2H + Cl \rightarrow C_2H_5O_2 + HCl$	5.70×10^{-11}	2	Sander et al. (1997)
(SR95)	$Cl + HO_2 \rightarrow HCl + O_2$	3.61×10^{-11}	2	Atkinson et al. (2006)
(SR96)	$Cl + HO_2 \rightarrow ClO + HO$	$6.30 \times 10^{-11}\exp(-570/T)$	2	Atkinson et al. (2006)
(SR97)	$Cl + H_2O_2 \rightarrow HCl + HO_2$	$1.10 \times 10^{-11}\exp(-980/T)$	2	Atkinson et al. (2006)
(SR98)	$Cl + O_3 \rightarrow ClO + O_2$	$2.80 \times 10^{-11}\exp(-250/T)$	2	Atkinson et al. (2006)
(SR99)	$Cl + CH_4 \rightarrow HCl + CH_3O_2$	$6.60 \times 10^{-12}\exp(-1240/T)$	2	Atkinson et al. (2006)
(SR100)	$Cl + C_2H_2 \rightarrow 2CO + 2HO_2 + Cl$	2.00×10^{-11}	2	Borken (1996)
(SR101)	$Cl + C_2H_2 \rightarrow 2CO + HO_2 + HCl$	4.24×10^{-11}	2	Borken (1996)
(SR102)	$Cl + C_2H_4(+M) \rightarrow 2CO + 2HO_2 + Cl + H_2O(+M)$	$k_0 = 0.59 \times 10^{-29}(T/300)^{-3.3}[\text{air}]$	2	Atkinson et al. (2006)
		$k_\infty = 6.00 \times 10^{-10}$		
		$F_c = 0.40$		
(SR103)	$Cl + C_2H_4(+M) \rightarrow 2CO + HO_2 + HCl + H_2O(+M)$	$k_0 = 1.26 \times 10^{-29}(T/300)^{-3.3}[\text{air}]$	2	Atkinson et al. (2006)
		$k_\infty = 6.00 \times 10^{-10}$		
		$F_c = 0.40$		
(SR104)	$Cl + C_2H_6 \rightarrow C_2H_5 + HCl$	$8.30 \times 10^{-11}\exp(-100/T)$	2	Atkinson et al. (2006)
(SR105)	$Cl + C_3H_8 \rightarrow C_2H_5O_2 + HCl + H_2O + CO_2$	1.40×10^{-10}	2	Atkinson et al. (2006)
(SR106)	$Cl + HCHO \rightarrow HCl + CO + HO_2$	$8.10 \times 10^{-11}\exp(-34/T)$	2	Atkinson et al. (2006)
(SR107)	$Cl + CH_3CHO \rightarrow CH_3CO_3 + HCl$	8.00×10^{-11}	2	Atkinson et al. (2006)
(SR108)	$OH + Cl_2 \rightarrow HOCl + Cl$	$3.60 \times 10^{-12}\exp(-1200/T)$	2	Atkinson et al. (2006)
(SR109)	$OH + HCl \rightarrow Cl + H_2O$	$1.80 \times 10^{-12}\exp(-240/T)$	2	Atkinson et al. (2006)
(SR110)	$OH + HOCl \rightarrow ClO + H_2O$	5.00×10^{-13}	2	Atkinson et al. (2006)
(SR111)	$OH + ClO \rightarrow Cl + HO_2$	$6.86 \times 10^{-12}\exp(300/T)$	2	Atkinson et al. (2006)
(SR112)	$OH + ClO \rightarrow HCl + O_2$	$4.37 \times 10^{-13}\exp(300/T)$	2	Atkinson et al. (2006)
(SR113)	$ClO + ClO \rightarrow Cl_2 + O_2$	$1.00 \times 10^{-12}\exp(-1590/T)$	2	Atkinson et al. (2006)
(SR114)	$ClO + ClO \rightarrow 2Cl + O_2$	$3.00 \times 10^{-11}\exp(-2450/T)$	2	Atkinson et al. (2006)
(SR115)	$ClO + ClO \rightarrow Cl + OClO$	$3.50 \times 10^{-13}\exp(-1370/T)$	2	Atkinson et al. (2006)

Table S3. (continued).

Reaction Number	Reaction	k $[(\text{molec. cm}^{-3})^{1-n}\text{s}^{-1}]$	Order n	Reference
(SR116)	$ClO + ClO(+M) \rightarrow Cl_2O_2(+M)$	$k_0 = 2.00 \times 10^{-32}(T/300)^{-4}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 1.00 \times 10^{-11}$		
		$F_c = 0.45$		
(SR117)	$Cl_2O_2(+M) \rightarrow 2ClO(+M)$	$k_0 = 3.70 \times 10^{-7}\exp(-7690/T)[N_2]$	1	Atkinson et al. (2006)
		$k_\infty = 1.80 \times 10^{14}\exp(-7690/T)$		
		$F_c = 0.45$		
(SR118)	$ClO + HO_2 \rightarrow HOCl + O_2$	$2.20 \times 10^{-12}\exp(340/T)$	2	Atkinson et al. (2006)
(SR119)	$ClO + CH_3O_2 \rightarrow Cl + CH_2O + HO_2$	$2.40 \times 10^{-12}\exp(-20/T)$	2	Atkinson et al. (2006)
(SR120)	$ClO + NO \rightarrow Cl + NO_2$	$6.20 \times 10^{-12}\exp(295/T)$	2	Atkinson et al. (2006)
(SR121)	$ClO + NO_2(+M) \rightarrow ClONO_2(+M)$	$k_0 = 1.60 \times 10^{-31}(T/300)^{-3.4}[N_2]$	2	Atkinson et al. (2006)
		$k_\infty = 7.00 \times 10^{-11}$		
		$F_c = 0.40$		
(SR122)	$Cl + ClONO_2 \rightarrow Cl_2 + NO_3$	$6.20 \times 10^{-12}\exp(145/T)$	2	Atkinson et al. (2006)
(SR123)	$OClO + NO \rightarrow NO_2 + ClO$	$1.10 \times 10^{-13}\exp(350/T)$	2	Atkinson et al. (2006)
(SR124)	$OH + ClONO_2 \rightarrow HOCl + NO_3$	$1.20 \times 10^{-12}\exp(-330/T)$	2	Atkinson et al. (2006)
(SR125)	$ClO + BrO \rightarrow Br + OClO$	$1.60 \times 10^{-12}\exp(430/T)$	2	Atkinson et al. (2006)
(SR126)	$ClO + BrO \rightarrow Br + Cl + O_2$	$2.90 \times 10^{-12}\exp(220/T)$	2	Atkinson et al. (2006)
(SR127)	$ClO + BrO \rightarrow BrCl + O_2$	$5.80 \times 10^{-13}\exp(170/T)$	2	Atkinson et al. (2006)
(SR128)	$Br + OClO \rightarrow BrO + ClO$	$2.70 \times 10^{-11}\exp(-1300/T)$	2	Atkinson et al. (2006)
(SR129)	$Br + Cl_2O_2 \rightarrow BrCl + ClOO$	3.00×10^{-12}	2	Atkinson et al. (2006)
(SR130)	$Br_2 + Cl \rightarrow BrCl + Br$	1.20×10^{-10}	2	Sander and Crutzen (1996)
(SR131)	$BrCl + Br \rightarrow Br_2 + Cl$	3.30×10^{-15}	2	Sander and Crutzen (1996)
(SR132)	$Br + Cl_2 \rightarrow BrCl + Cl$	1.10×10^{-15}	2	Sander and Crutzen (1996)
(SR133)	$BrCl + Cl \rightarrow Br + Cl_2$	1.50×10^{-11}	2	Sander and Crutzen (1996)
(SR134)	$HOBr + H^+ + Cl^- \xrightarrow{\text{ice}} BrCl + H_2O$	3.03×10^{-5}	$(r_a + r_b + r_c)^{-1}\alpha_{\text{eff,ice}}$	Cao et al. (2014)
(SR135)	$BrCl + h\nu \rightarrow Br + Cl$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR136)	$Cl_2 + h\nu \rightarrow Cl$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR137)	$ClO + h\nu \rightarrow Cl + O_3$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR138)	$HOCl + h\nu \rightarrow HO + Cl$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR139)	$ClONO_2 + h\nu \rightarrow NO_3 + Cl$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR140)	$OClO + h\nu \rightarrow O_3 + ClO$	calculated by TUV model	1	Madronich and Flocke (1997, 1999)
(SR141)	$HOBr + HCl \xrightarrow{\text{aerosol}} BrCl + H_2O$	$(\frac{r}{D_g} + \frac{4}{v_{\text{therm}}\gamma})^{-1}\alpha_{\text{eff,aerosol}}$		Cao et al. (2014)

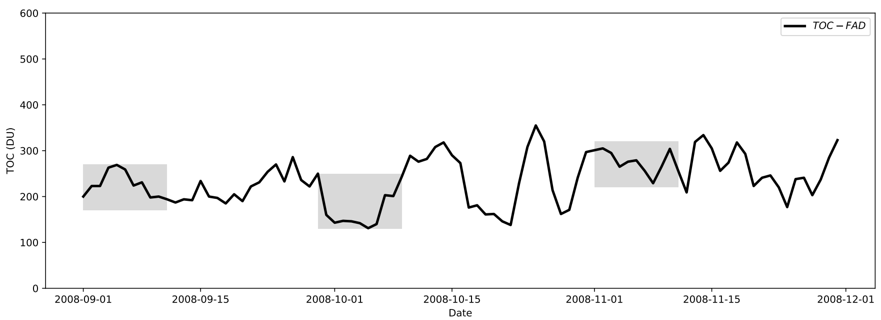

Figure S2. Time series of the total ozone column (TOC) detected at the Faraday-Vernadsky (FAD) station during the springtime of the year 2008. The gray-shaded areas in the figure indicate the periods investigated in the sensitivity tests of the present study.

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