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Stratospheric ozone loss in the Arctic winters between 2005 and 2013 derived with ACE-FTS measurements

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Table S1. Linear combination needed to obtain the artificial Tracer 1 that is linearly correlated with ozone (in ppbv), estimated for each year.

Year	$[CH_4]_{ppb}$	$[N_2O]_{ppb}$	$[CCl_2F_2]_{ppt}$	$[CCl_3F]_{ppt}$	intercept	R^2
2005	7.23×10^{-3}	-2.28×10^{-2}	-2.14×10^{-3}	-1.16×10^{-2}	0.24	0.81
2007	3.31×10^{-3}	5.35×10^{-3}	-1.34×10^{-2}	-8.83×10^{-3}	1.69	0.87
2008	3.31×10^{-3}	5.35×10^{-3}	-1.34×10^{-2}	-8.83×10^{-3}	1.69	0.87
2010	1.14×10^{-3}	-7.65×10^{-3}	9.38×10^{-4}	-1.14×10^{-2}	2.81	0.88
2011	9.34×10^{-4}	-7.45×10^{-4}	-3.41×10^{-3}	-9.46×10^{-3}	2.86	0.90

Table S2. Linear combination needed to obtain the artificial Tracer 4 that is linearly correlated with ozone (in ppbv), estimated for each year.

Year	$[CH_4]_{ppb}$	$[N_2O]_{ppb}$	$[OCS]_{ppt}$	$[CCl_2F_2]_{ppt}$	intercept	R^2
2005	7.80×10^{-3}	-3.77×10^{-2}	4.51×10^{-3}	-1.60×10^{-2}	0.11	0.81
2007	2.78×10^{-3}	-1.14×10^{-2}	-1.99×10^{-3}	-1.13×10^{-2}	2.11	0.85
2008	2.78×10^{-3}	-1.14×10^{-2}	-1.99×10^{-3}	-1.13×10^{-2}	2.11	0.85
2010	1.78×10^{-4}	1.39×10^{-3}	-4.84×10^{-3}	-6.56×10^{-3}	3.09	0.89
2011	2.22×10^{-4}	-5.03×10^{-4}	-3.91×10^{-3}	-6.05×10^{-3}	3.15	0.90

Table S3. Average vortex descent (in K/1.5 months) estimated with CH_4.

Year	380-400 K	400-420 K	420-440K	440-460 K	460-480 K	480-500 K	500-520 K	520-540 K
2005	5.46	4.91	1.53	3.17	-5.67	-16.66	-20.75	-31.84
2007	-2.75	-0.75	-4.23	-7.43	-10.05	-7.49	-11.38	-6.42
2008	-1.04	-3.08	-9.63	-10.69	-22.21	-27.44	-29.48	-31.93
2010	0.98	1.34	-2.36	-3.48	-9.01	-12.23	-12.55	-18.94
2011	2.30	-5.17	-9.28	-10.93	-18.06	-24.67	-26.60	-26.13

Table S4. Average vortex descent (in K/1.5 months) estimated with N_2O.

Year	380-400 K	400-420 K	420-440K	440-460 K	460-480 K	480-500 K	500-520 K	520-540 K
2005	5.71	4.68	-0.39	3.21	-4.98	-13.07	-12.72	-22.26
2007	-3.81	-0.57	-3.89	-7.95	-6.76	-3.44	1.33	7.87
2008	-0.28	-2.88	-10.63	-12.71	-23.38	-26.59	-23.03	-21.85
2010	1.34	1.88	-2.29	-4.19	-8.01	-7.69	-4.58	-7.60
2011	6.10	-3.98	-8.43	-11.73	-18.81	-24.34	-22.91	-19.90

Table S5. Average vortex descent (in K/1.5 months) estimated with HF.

Year	380-400 K	400-420 K	420-440K	440-460 K	460-480 K	480-500 K	500-520 K	520-540 K
2005	5.08	2.17	-2.37	1.40	-7.39	-16.13	-21.33	-30.35
2007	-3.04	-3.34	-9.70	-14.10	-21.23	-15.94	-32.31	-32.97
2008	-2.43	-3.06	-12.70	-13.75	-22.39	-28.40	-29.12	-31.41
2010	1.46	2.96	-0.49	-2.48	-11.17	-13.91	-19.51	-21.60
2011	-7.42	-7.17	-13.45	-16.11	-21.27	-25.42	-26.14	-24.85

Table S6. Average vortex descent (in K/1.5 months) estimated with CCl_2F_2.

Year	380-400 K	400-420 K	420-440K	440-460 K	460-480 K	480-500 K	500-520 K	520-540 K
2005	2.70	3.80	-0.60	4.03	-3.24	-10.82	-12.30	-22.65
2007	-8.39	-3.24	-3.41	-8.12	-6.78	-1.32	4.12	9.90
2008	-6.33	-3.66	-10.20	-12.88	-22.88	-28.36	-25.74	-24.16
2010	-0.27	1.03	-1.92	-4.52	-8.97	-10.55	-7.85	-10.80
2011	-3.81	-4.45	-8.72	-12.69	-19.52	-24.85	-22.26	-19.74

Table S7. Average vortex descent (in K/1.5 months) estimated with OCS.

Year	380-400 K	400-420 K	420-440K	440-460 K	460-480 K	480-500 K	500-520 K	520-540 K
2005	10.49	6.98	0.61	10.54	5.87	2.01	2.08	-8.52
2007	-8.22	5.49	-6.33	-3.68	22.14	34.45	38.06	30.14
2008	2.27	1.25	-12.91	-12.85	-15.13	-12.37	-0.66	8.56
2010	2.78	6.12	-2.91	-1.26	0.25	7.39	15.58	5.47
2011	6.45	3.37	-9.75	-14.45	-15.26	-13.26	-5.79	-7.20

Table S8. Average vortex descent (in K/1.5 months) estimated with CCl_3F.

Year	380-400 K	400-420 K	420-440K	440-460 K	460-480 K	480-500 K	500-520 K	520-540 K
2010	4.93	7.55	-7.37	-0.44	4.19	7.85	18.98	-4.14

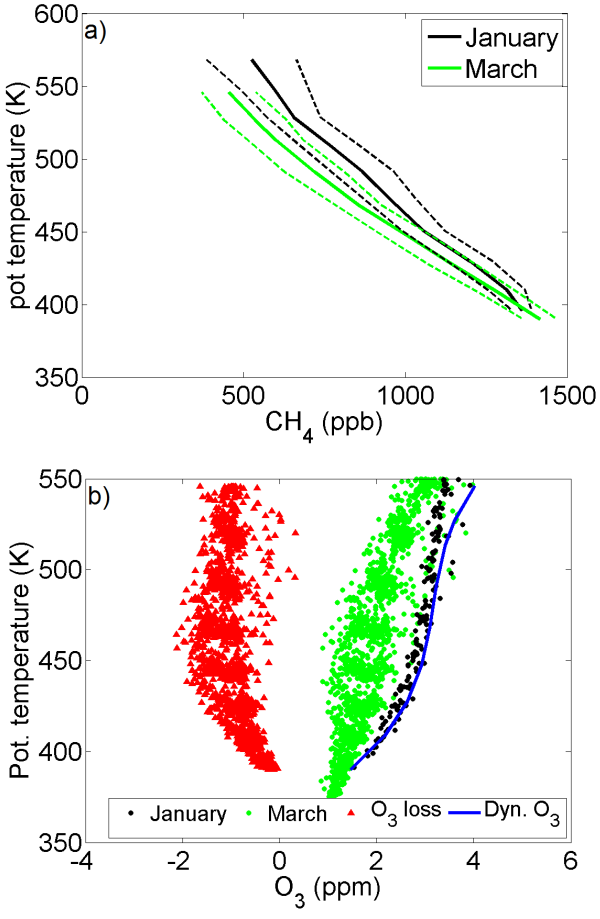

Figure S1. Panel (a) shows the monthly average CH_4 profiles observed by ACE-FTS inside the polar vortex in January (black line) and March (green line) 2011 together with the respective standard deviations (shown as dashed lines). Panel (b) displays the observed ACE-FTS ozone in January (black dots) and March (green dots) 2011, the dynamic ozone (blue line) for March 2011, estimated from the average vortex profile descent from CH_4, and the ozone loss (red triangles; the difference between observed and average passive ozone in March).

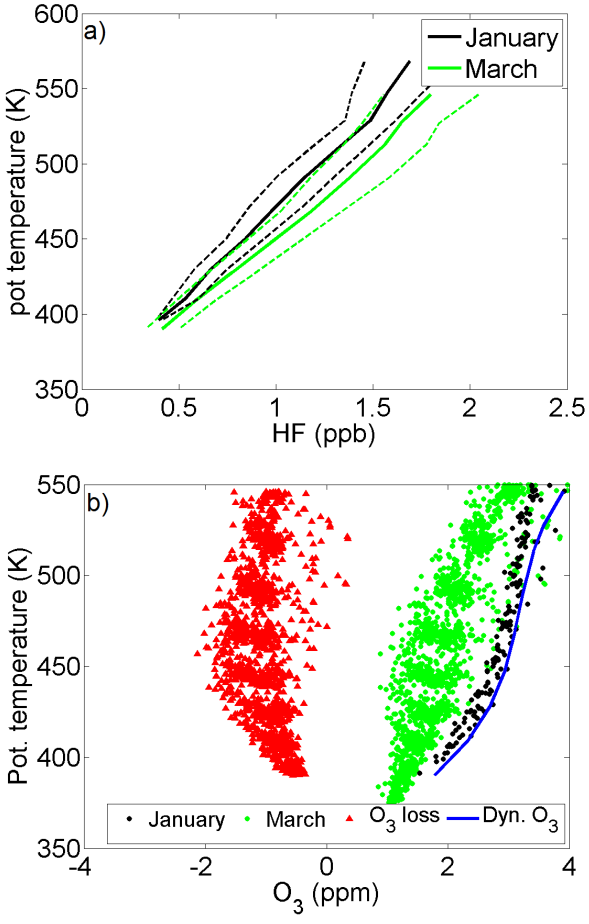

Figure S2. Panel (a) shows the monthly average HF profiles observed by ACE-FTS inside the polar vortex in January (black line) and March (green line) 2011 together with the respective standard deviations (shown as dashed lines). Panel (b) displays the observed ACE-FTS ozone in January (black dots) and March (green dots) 2011, the dynamic ozone (blue line) for March 2011, estimated from the average vortex profile descent from HF, and the ozone loss (red triangles; the difference between observed and average passive ozone in March).

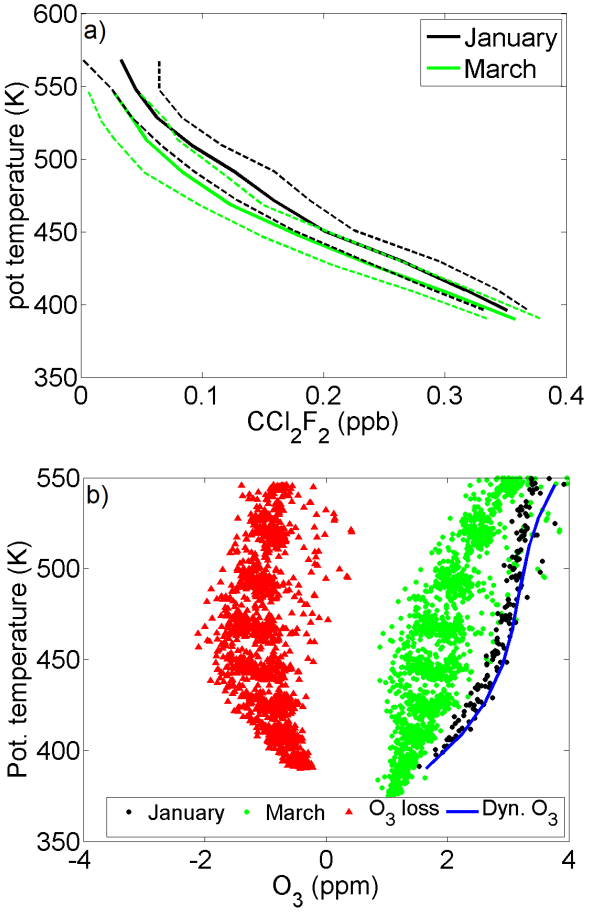

Figure S3. Panel (a) shows the monthly average CCl_2F_2 profiles observed by ACE-FTS inside the polar vortex in January (black line) and March (green line) 2011 together with the respective standard deviations (shown as dashed lines). Panel (b) displays the observed ACE-FTS ozone in January (black dots) and March (green dots) 2011, the dynamic ozone (blue line) for March 2011, estimated from the average vortex profile descent from CCl_2F_2, and the ozone loss (red triangles; the difference between observed and average passive ozone in March).

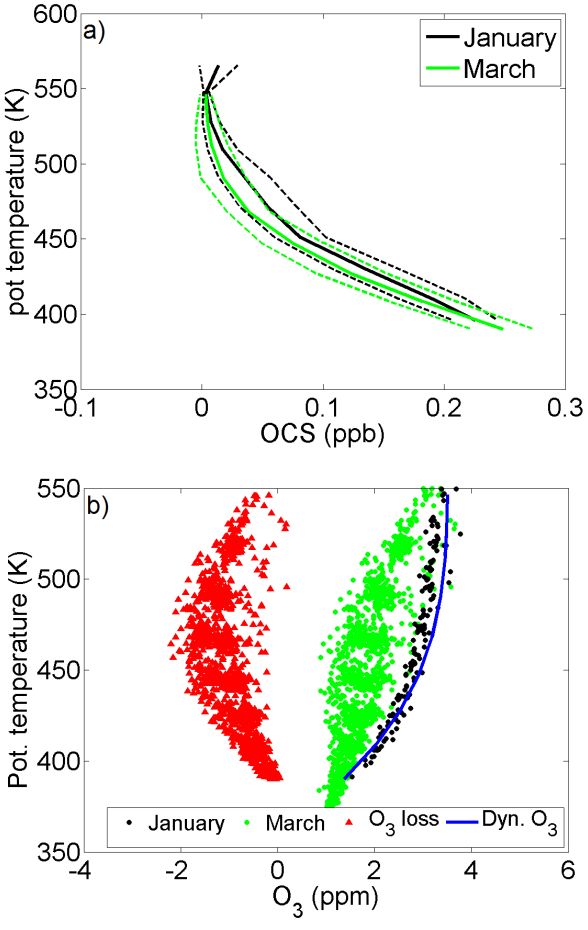

Figure S4. Panel (a) shows the monthly average OCS profiles observed by ACE-FTS inside the polar vortex in January (black line) and March (green line) 2011 together with the respective standard deviations (shown as dashed lines). Panel (b) displays the observed ACE-FTS ozone in January (black dots) and March (green dots) 2011, the dynamic ozone (blue line) for March 2011, estimated from the average vortex profile descent from OCS, and the ozone loss (red triangles; the difference between observed and average passive ozone in March).