



Supplement of

Observed changes in stratospheric circulation: decreasing lifetime of N₂O, 2005–2021

Michael J. Prather et al.

Correspondence to: Michael J. Prather (mprather@uci.edu)

The copyright of individual parts of the supplement might differ from the article licence.

This Supplement contains data tables of the time series plotted in the paper. It also includes the time series and figures for the N₂O stratospheric abundances (f-N₂O) in northern and southern mid-latitude stratosphere that were discussed but not plotted or shown un the main text.

Note that Tables S1-S5 contain 12-month running mean data (from 2005.08 to 2021.5), while Table S8 contains the MLS-calculated monthly N₂O loss data (2004.63 to 2021.96).

Contents:

Table S1.

Table S2.

Table S3.

Table S4.

Table S5.

Table S6. Summary of linear trends fitted to time series of f-N₂O (ppb)

Table S7. N₂O budget table

Table S8. Calculated monthly loss of N₂O

Figure S1. Time series of stratospheric f-N₂O (ppb, dry air mole fraction) at **(a)** northern mid-latitudes (30 °N – 58 °N) and **(b)** southern mid-latitudes (30 °S – 58 °S). See main text Fig. 1

Figure S2. Projected N₂O tropospheric annual mean abundance (black line) assuming the observed 2.9 %/decade growth rate. The last observed decade 2012-2021 is used to project future decades, and hence there is a recurring interannual variability (IAV). Projected N₂O with the lifetime decreasing by 2.1 %/decade from 120 y in 2000 to 97 y in 2100 (blue dotted line) uses the emissions inferred from fixed growth scenario. The RCP scenario projections, shown for perspective, are taken from the Annex II tables of the IPCC WGI AR4 (2013).

Table S1.

year	loss (TgN/y)	burden (TgN)	lifetime (y)	prod NO (TgN/y)
	fig 1A	fig 1B	fig 1C	fig 1D
2005.08	12.92	1523.0	117.90	0.7538
2005.17	12.99	1523.3	117.20	0.7570
2005.25	13.02	1523.5	117.00	0.7578
2005.33	13.00	1523.9	117.30	0.7563
2005.42	12.98	1524.2	117.40	0.7551
2005.50	13.04	1524.5	116.90	0.7586
2005.58	13.20	1524.8	115.50	0.7670
2005.67	13.33	1525.2	114.40	0.7734
2005.75	13.35	1525.5	114.30	0.7746
2005.83	13.29	1525.9	114.80	0.7720
2005.92	13.17	1526.3	115.90	0.7670
2006.00	13.04	1526.7	117.10	0.7616
2006.08	12.91	1527.1	118.30	0.7555
2006.17	12.76	1527.5	119.70	0.7484
2006.25	12.65	1527.9	120.80	0.7430
2006.33	12.58	1528.2	121.50	0.7392
2006.42	12.54	1528.5	121.90	0.7375
2006.50	12.47	1528.8	122.60	0.7330
2006.58	12.34	1529.1	123.90	0.7261
2006.67	12.25	1529.3	124.80	0.7216
2006.75	12.27	1529.5	124.60	0.7225
2006.83	12.36	1529.7	123.70	0.7269
2006.92	12.50	1529.9	122.40	0.7330
2007.00	12.62	1530.2	121.20	0.7385
2007.08	12.75	1530.4	120.00	0.7441
2007.17	12.88	1530.6	118.80	0.7505
2007.25	12.97	1530.9	118.00	0.7552
2007.33	13.03	1531.2	117.50	0.7588
2007.42	13.05	1531.5	117.30	0.7603
2007.50	13.09	1531.8	117.00	0.7625
2007.58	13.16	1532.2	116.40	0.7669
2007.67	13.28	1532.6	115.40	0.7736
2007.75	13.36	1533.0	114.80	0.7781
2007.83	13.35	1533.5	114.90	0.7779
2007.92	13.27	1534.0	115.60	0.7743
2008.00	13.17	1534.5	116.50	0.7703
2008.08	13.06	1534.9	117.60	0.7652
2008.17	12.93	1535.4	118.80	0.7587
2008.25	12.83	1535.8	119.70	0.7537
2008.33	12.79	1536.2	120.20	0.7516
2008.42	12.79	1536.5	120.10	0.7518
2008.50	12.79	1536.9	120.10	0.7517
2008.58	12.75	1537.2	120.60	0.7490
2008.67	12.68	1537.6	121.30	0.7443
2008.75	12.58	1537.9	122.20	0.7390
2008.83	12.56	1538.2	122.50	0.7376
2008.92	12.62	1538.5	121.90	0.7400
2009.00	12.71	1538.6	121.10	0.7437
2009.08	12.80	1538.9	120.20	0.7476
2009.17	12.88	1539.1	119.50	0.7509

2009.25	12.93	1539.4	119.00	0.7532
2009.33	12.94	1539.8	119.00	0.7532
2009.42	12.96	1540.1	118.80	0.7538
2009.50	13.06	1540.4	118.00	0.7584
2009.58	13.17	1540.7	117.00	0.7642
2009.67	13.25	1541.0	116.30	0.7684
2009.75	13.30	1541.2	115.90	0.7707
2009.83	13.31	1541.6	115.80	0.7715
2009.92	13.31	1542.0	115.90	0.7713
2010.00	13.29	1542.4	116.10	0.7707
2010.08	13.29	1542.8	116.10	0.7718
2010.17	13.36	1543.2	115.50	0.7763
2010.25	13.40	1543.6	115.20	0.7798
2010.33	13.41	1544.0	115.10	0.7816
2010.42	13.37	1544.4	115.60	0.7806
2010.50	13.28	1544.8	116.30	0.7776
2010.58	13.26	1545.3	116.50	0.7780
2010.67	13.31	1545.8	116.10	0.7817
2010.75	13.43	1546.2	115.20	0.7887
2010.83	13.53	1546.7	114.40	0.7932
2010.92	13.62	1547.1	113.60	0.7971
2011.00	13.67	1547.6	113.20	0.7989
2011.08	13.67	1548.0	113.20	0.7981
2011.17	13.62	1548.4	113.70	0.7943
2011.25	13.57	1548.8	114.10	0.7911
2011.33	13.55	1549.1	114.30	0.7890
2011.42	13.58	1549.4	114.10	0.7896
2011.50	13.60	1549.8	114.00	0.7892
2011.58	13.57	1550.2	114.20	0.7867
2011.67	13.47	1550.5	115.10	0.7800
2011.75	13.32	1550.9	116.40	0.7720
2011.83	13.21	1551.2	117.40	0.7669
2011.92	13.09	1551.5	118.50	0.7615
2012.00	13.01	1551.8	119.30	0.7578
2012.08	12.97	1552.1	119.70	0.7562
2012.17	12.97	1552.5	119.70	0.7569
2012.25	12.98	1552.9	119.60	0.7577
2012.33	12.98	1553.2	119.60	0.7578
2012.42	12.92	1553.5	120.20	0.7551
2012.50	12.81	1553.8	121.30	0.7502
2012.58	12.74	1554.1	122.00	0.7476
2012.67	12.74	1554.3	122.00	0.7483
2012.75	12.76	1554.6	121.90	0.7493
2012.83	12.75	1554.9	122.00	0.7492
2012.92	12.71	1555.3	122.30	0.7482
2013.00	12.66	1555.7	122.90	0.7466
2013.08	12.61	1556.1	123.40	0.7450
2013.17	12.58	1556.5	123.70	0.7440
2013.25	12.61	1556.9	123.40	0.7462
2013.33	12.69	1557.2	122.70	0.7509
2013.42	12.79	1557.6	121.80	0.7559
2013.50	12.85	1558.0	121.20	0.7590
2013.58	12.80	1558.4	121.70	0.7561
2013.67	12.74	1558.9	122.40	0.7529

2013.75	12.73	1559.3	122.40	0.7532
2013.83	12.81	1559.7	121.80	0.7570
2013.92	12.93	1560.1	120.60	0.7625
2014.00	13.06	1560.5	119.50	0.7677
2014.08	13.17	1560.9	118.60	0.7720
2014.17	13.24	1561.4	117.90	0.7752
2014.25	13.26	1561.9	117.80	0.7755
2014.33	13.25	1562.4	117.90	0.7745
2014.42	13.26	1562.9	117.90	0.7745
2014.50	13.35	1563.5	117.10	0.7791
2014.58	13.50	1564.1	115.90	0.7864
2014.67	13.59	1564.6	115.10	0.7909
2014.75	13.58	1565.1	115.20	0.7900
2014.83	13.51	1565.6	115.90	0.7863
2014.92	13.43	1566.0	116.60	0.7822
2015.00	13.37	1566.5	117.10	0.7797
2015.08	13.35	1566.9	117.40	0.7785
2015.17	13.31	1567.2	117.80	0.7760
2015.25	13.26	1567.6	118.20	0.7737
2015.33	13.21	1567.9	118.70	0.7712
2015.42	13.14	1568.3	119.40	0.7680
2015.50	13.04	1568.7	120.30	0.7622
2015.58	12.91	1569.0	121.50	0.7553
2015.67	12.86	1569.3	122.00	0.7523
2015.75	12.92	1569.7	121.50	0.7550
2015.83	13.03	1570.1	120.50	0.7596
2015.92	13.13	1570.5	119.60	0.7637
2016.00	13.21	1570.8	118.90	0.7668
2016.08	13.27	1571.1	118.40	0.7691
2016.17	13.33	1571.4	117.90	0.7720
2016.25	13.40	1571.7	117.30	0.7754
2016.33	13.44	1571.9	116.90	0.7771
2016.42	13.48	1572.2	116.60	0.7787
2016.50	13.50	1572.4	116.40	0.7801
2016.58	13.53	1572.6	116.30	0.7816
2016.67	13.55	1572.9	116.10	0.7834
2016.75	13.56	1573.1	116.00	0.7846
2016.83	13.57	1573.4	115.90	0.7858
2016.92	13.59	1573.6	115.80	0.7868
2017.00	13.58	1573.9	115.90	0.7867
2017.08	13.58	1574.2	115.90	0.7866
2017.17	13.60	1574.6	115.70	0.7877
2017.25	13.64	1575.0	115.50	0.7890
2017.33	13.70	1575.4	115.00	0.7915
2017.42	13.76	1575.8	114.50	0.7946
2017.50	13.84	1576.2	113.90	0.7977
2017.58	13.90	1576.6	113.40	0.8005
2017.67	13.91	1577.0	113.30	0.8006
2017.75	13.86	1577.5	113.90	0.7969
2017.83	13.75	1578.0	114.70	0.7914
2017.92	13.67	1578.5	115.50	0.7874
2018.00	13.63	1578.9	115.80	0.7854
2018.08	13.59	1579.3	116.20	0.7833
2018.17	13.53	1579.7	116.70	0.7803

2018.25	13.45	1580.2	117.50	0.7768
2018.33	13.35	1580.7	118.40	0.7723
2018.42	13.24	1581.3	119.40	0.7673
2018.50	13.21	1581.8	119.80	0.7661
2018.58	13.30	1582.3	119.00	0.7714
2018.67	13.41	1582.8	118.00	0.7771
2018.75	13.54	1583.2	116.90	0.7844
2018.83	13.70	1583.5	115.60	0.7923
2018.92	13.81	1583.9	114.70	0.7983
2019.00	13.86	1584.3	114.30	0.8011
2019.08	13.87	1584.7	114.20	0.8027
2019.17	13.88	1585.1	114.20	0.8033
2019.25	13.93	1585.4	113.80	0.8056
2019.33	14.04	1585.7	112.90	0.8108
2019.42	14.16	1586.1	112.00	0.8165
2019.50	14.25	1586.4	111.40	0.8208
2019.58	14.24	1586.6	111.40	0.8203
2019.67	14.20	1587.0	111.80	0.8181
2019.75	14.14	1587.3	112.20	0.8152
2019.83	14.12	1587.8	112.50	0.8132
2019.92	14.12	1588.3	112.50	0.8125
2020.00	14.17	1588.8	112.10	0.8139
2020.08	14.22	1589.2	111.70	0.8158
2020.17	14.28	1589.7	111.30	0.8181
2020.25	14.28	1590.3	111.30	0.8180
2020.33	14.22	1590.8	111.90	0.8145
2020.42	14.14	1591.4	112.60	0.8100
2020.50	14.04	1591.9	113.40	0.8041
2020.58	13.97	1592.5	114.00	0.7996
2020.67	13.93	1593.0	114.40	0.7965
2020.75	13.86	1593.6	115.00	0.7929
2020.83	13.79	1594.2	115.60	0.7894
2020.92	13.73	1594.7	116.20	0.7867
2021.00	13.66	1595.2	116.70	0.7838
2021.08	13.60	1595.7	117.30	0.7808
2021.17	13.54	1596.1	117.90	0.7775
2021.25	13.47	1596.6	118.50	0.7742
2021.33	13.44	1597.0	118.90	0.7720
2021.42	13.45	1597.6	118.80	0.7724
2021.50	13.52	1598.1	118.20	0.7762

Table S2.

year	j-N2O 30S-30N (1e-7/s)							
	fig 1E							
pressure	15 hPa	12 hPa	10 hPa	8.3 hPa	6.8 hPa	5.6 hPa	4.6 hPa	3.8 hPa
2005.08	0.156	0.232	0.333	0.459	0.612	0.787	0.979	1.179
2005.17	0.156	0.233	0.334	0.460	0.613	0.788	0.980	1.180
2005.25	0.156	0.233	0.334	0.461	0.614	0.789	0.980	1.180
2005.33	0.156	0.233	0.334	0.462	0.615	0.789	0.980	1.180
2005.42	0.156	0.233	0.335	0.462	0.615	0.789	0.980	1.179
2005.50	0.156	0.233	0.334	0.461	0.613	0.787	0.977	1.177
2005.58	0.155	0.232	0.333	0.459	0.611	0.785	0.975	1.175
2005.67	0.156	0.233	0.334	0.460	0.612	0.786	0.976	1.176
2005.75	0.156	0.234	0.335	0.461	0.613	0.787	0.977	1.176
2005.83	0.157	0.235	0.336	0.462	0.613	0.787	0.976	1.176
2005.92	0.158	0.235	0.336	0.462	0.613	0.786	0.976	1.175
2006.00	0.158	0.236	0.337	0.462	0.613	0.786	0.975	1.175
2006.08	0.159	0.237	0.337	0.463	0.613	0.786	0.976	1.175
2006.17	0.160	0.237	0.338	0.463	0.614	0.787	0.976	1.176
2006.25	0.160	0.238	0.338	0.463	0.614	0.787	0.977	1.177
2006.33	0.160	0.238	0.338	0.463	0.614	0.787	0.977	1.177
2006.42	0.160	0.238	0.338	0.463	0.614	0.787	0.977	1.177
2006.50	0.161	0.238	0.339	0.464	0.615	0.789	0.979	1.179
2006.58	0.161	0.239	0.339	0.465	0.616	0.791	0.981	1.181
2006.67	0.161	0.238	0.338	0.464	0.615	0.789	0.980	1.180
2006.75	0.160	0.237	0.337	0.463	0.615	0.789	0.980	1.180
2006.83	0.159	0.237	0.337	0.463	0.615	0.789	0.980	1.180
2006.92	0.159	0.236	0.336	0.463	0.615	0.790	0.981	1.181
2007.00	0.158	0.236	0.336	0.463	0.616	0.790	0.982	1.182
2007.08	0.158	0.235	0.336	0.462	0.615	0.790	0.981	1.182
2007.17	0.158	0.235	0.336	0.462	0.615	0.789	0.981	1.181
2007.25	0.158	0.235	0.336	0.462	0.615	0.789	0.980	1.180
2007.33	0.158	0.235	0.337	0.463	0.615	0.788	0.979	1.180
2007.42	0.158	0.236	0.337	0.463	0.615	0.789	0.980	1.180
2007.50	0.158	0.236	0.338	0.464	0.616	0.790	0.981	1.181
2007.58	0.158	0.236	0.338	0.464	0.615	0.789	0.980	1.180
2007.67	0.158	0.236	0.337	0.463	0.615	0.788	0.979	1.179
2007.75	0.158	0.236	0.337	0.463	0.614	0.787	0.978	1.178
2007.83	0.159	0.237	0.338	0.463	0.614	0.787	0.977	1.178
2007.92	0.159	0.238	0.338	0.463	0.614	0.786	0.977	1.178
2008.00	0.160	0.238	0.338	0.463	0.613	0.786	0.977	1.178
2008.08	0.160	0.239	0.339	0.464	0.614	0.787	0.978	1.179
2008.17	0.161	0.239	0.340	0.465	0.615	0.788	0.979	1.180
2008.25	0.161	0.239	0.340	0.465	0.616	0.789	0.980	1.181
2008.33	0.161	0.239	0.339	0.464	0.615	0.789	0.980	1.181
2008.42	0.160	0.238	0.339	0.464	0.615	0.789	0.980	1.182
2008.50	0.160	0.238	0.338	0.463	0.615	0.789	0.980	1.181
2008.58	0.160	0.238	0.338	0.463	0.615	0.789	0.980	1.181
2008.67	0.160	0.238	0.338	0.464	0.616	0.791	0.983	1.184
2008.75	0.160	0.238	0.339	0.465	0.618	0.793	0.985	1.186
2008.83	0.159	0.237	0.339	0.465	0.618	0.793	0.986	1.187
2008.92	0.159	0.237	0.338	0.465	0.618	0.794	0.986	1.187
2009.00	0.158	0.236	0.337	0.465	0.618	0.794	0.986	1.187
2009.08	0.158	0.236	0.337	0.465	0.618	0.794	0.986	1.187
2009.17	0.158	0.236	0.337	0.465	0.618	0.793	0.985	1.186
2009.25	0.158	0.236	0.337	0.465	0.618	0.793	0.985	1.186
2009.33	0.158	0.236	0.338	0.466	0.619	0.793	0.985	1.186
2009.42	0.158	0.236	0.339	0.466	0.619	0.793	0.984	1.185
2009.50	0.158	0.236	0.338	0.465	0.618	0.792	0.983	1.183
2009.58	0.158	0.236	0.338	0.466	0.618	0.791	0.982	1.183
2009.67	0.158	0.236	0.338	0.465	0.617	0.791	0.981	1.182
2009.75	0.157	0.236	0.338	0.465	0.617	0.790	0.981	1.182
2009.83	0.157	0.236	0.339	0.465	0.617	0.790	0.980	1.181
2009.92	0.158	0.236	0.339	0.466	0.617	0.790	0.981	1.182
2010.00	0.158	0.237	0.339	0.466	0.617	0.790	0.980	1.181
2010.08	0.158	0.237	0.339	0.465	0.616	0.788	0.978	1.179
2010.17	0.158	0.236	0.338	0.464	0.615	0.787	0.977	1.178
2010.25	0.158	0.236	0.338	0.464	0.614	0.787	0.977	1.177
2010.33	0.158	0.236	0.338	0.463	0.614	0.786	0.976	1.176
2010.42	0.158	0.236	0.338	0.463	0.613	0.785	0.975	1.175
2010.50	0.158	0.236	0.337	0.462	0.612	0.785	0.975	1.175
2010.58	0.158	0.236	0.336	0.461	0.611	0.784	0.974	1.175
2010.67	0.157	0.235	0.335	0.460	0.610	0.782	0.973	1.174
2010.75	0.157	0.234	0.334	0.459	0.609	0.781	0.971	1.173
2010.83	0.157	0.234	0.333	0.458	0.608	0.781	0.971	1.172

2010.92	0.156	0.233	0.333	0.457	0.608	0.781	0.971	1.172
2011.00	0.156	0.233	0.332	0.457	0.608	0.781	0.971	1.172
2011.08	0.156	0.233	0.333	0.458	0.609	0.782	0.973	1.175
2011.17	0.156	0.233	0.333	0.459	0.610	0.783	0.973	1.175
2011.25	0.156	0.233	0.333	0.459	0.610	0.784	0.974	1.176
2011.33	0.156	0.233	0.333	0.459	0.611	0.784	0.975	1.177
2011.42	0.155	0.232	0.333	0.460	0.611	0.785	0.976	1.178
2011.50	0.156	0.233	0.334	0.461	0.613	0.786	0.977	1.179
2011.58	0.156	0.233	0.335	0.462	0.613	0.787	0.978	1.180
2011.67	0.156	0.234	0.336	0.463	0.615	0.789	0.979	1.181
2011.75	0.156	0.234	0.336	0.464	0.615	0.789	0.979	1.181
2011.83	0.156	0.234	0.337	0.464	0.615	0.788	0.979	1.181
2011.92	0.157	0.235	0.337	0.464	0.615	0.788	0.978	1.180
2012.00	0.157	0.235	0.337	0.464	0.615	0.788	0.978	1.180
2012.08	0.157	0.235	0.337	0.463	0.614	0.786	0.976	1.178
2012.17	0.157	0.235	0.337	0.462	0.613	0.785	0.975	1.177
2012.25	0.157	0.235	0.336	0.461	0.611	0.783	0.973	1.175
2012.33	0.157	0.235	0.336	0.461	0.611	0.783	0.973	1.175
2012.42	0.158	0.236	0.336	0.462	0.612	0.784	0.974	1.175
2012.50	0.158	0.236	0.337	0.462	0.612	0.784	0.974	1.176
2012.58	0.158	0.236	0.337	0.462	0.612	0.784	0.974	1.175
2012.67	0.158	0.236	0.337	0.462	0.612	0.784	0.974	1.175
2012.75	0.159	0.237	0.337	0.461	0.611	0.784	0.974	1.175
2012.83	0.159	0.237	0.337	0.461	0.611	0.783	0.973	1.175
2012.92	0.159	0.237	0.337	0.461	0.610	0.782	0.972	1.174
2013.00	0.159	0.237	0.337	0.461	0.610	0.782	0.972	1.173
2013.08	0.159	0.237	0.337	0.460	0.610	0.782	0.972	1.174
2013.17	0.159	0.237	0.336	0.460	0.609	0.781	0.972	1.174
2013.25	0.159	0.236	0.335	0.459	0.609	0.781	0.972	1.174
2013.33	0.158	0.235	0.334	0.458	0.607	0.780	0.971	1.174
2013.42	0.158	0.234	0.333	0.457	0.606	0.779	0.971	1.173
2013.50	0.158	0.234	0.332	0.456	0.605	0.779	0.970	1.173
2013.58	0.158	0.234	0.332	0.456	0.606	0.780	0.971	1.174
2013.67	0.157	0.233	0.331	0.455	0.605	0.778	0.970	1.173
2013.75	0.156	0.232	0.330	0.454	0.604	0.777	0.969	1.172
2013.83	0.155	0.231	0.329	0.453	0.603	0.777	0.969	1.172
2013.92	0.155	0.230	0.328	0.452	0.603	0.778	0.970	1.173
2014.00	0.154	0.230	0.328	0.452	0.604	0.778	0.971	1.174
2014.08	0.154	0.229	0.328	0.452	0.604	0.778	0.970	1.174
2014.17	0.154	0.229	0.327	0.452	0.604	0.778	0.971	1.174
2014.25	0.154	0.229	0.327	0.452	0.604	0.778	0.970	1.173
2014.33	0.153	0.229	0.328	0.453	0.605	0.779	0.970	1.173
2014.42	0.153	0.228	0.328	0.453	0.604	0.778	0.969	1.172
2014.50	0.153	0.228	0.327	0.452	0.603	0.776	0.967	1.170
2014.58	0.152	0.228	0.327	0.452	0.603	0.776	0.966	1.169
2014.67	0.153	0.228	0.327	0.452	0.603	0.776	0.966	1.169
2014.75	0.153	0.229	0.328	0.454	0.604	0.777	0.967	1.170
2014.83	0.153	0.229	0.329	0.454	0.605	0.777	0.967	1.169
2014.92	0.154	0.230	0.330	0.455	0.605	0.777	0.967	1.169
2015.00	0.154	0.230	0.330	0.455	0.605	0.777	0.967	1.168
2015.08	0.154	0.231	0.330	0.455	0.606	0.778	0.968	1.169
2015.17	0.155	0.231	0.331	0.456	0.606	0.779	0.969	1.170
2015.25	0.155	0.232	0.332	0.457	0.607	0.779	0.969	1.171
2015.33	0.156	0.233	0.333	0.457	0.607	0.779	0.969	1.171
2015.42	0.157	0.233	0.333	0.457	0.607	0.780	0.970	1.172
2015.50	0.157	0.234	0.334	0.458	0.608	0.781	0.972	1.174
2015.58	0.157	0.234	0.334	0.458	0.609	0.782	0.973	1.175
2015.67	0.157	0.234	0.333	0.458	0.609	0.782	0.973	1.175
2015.75	0.156	0.233	0.332	0.456	0.607	0.781	0.972	1.175
2015.83	0.156	0.232	0.331	0.456	0.607	0.781	0.973	1.176
2015.92	0.156	0.232	0.331	0.455	0.606	0.781	0.973	1.176
2016.00	0.156	0.232	0.330	0.454	0.606	0.781	0.973	1.175
2016.08	0.156	0.232	0.330	0.454	0.606	0.780	0.972	1.175
2016.17	0.156	0.231	0.329	0.453	0.604	0.779	0.971	1.174
2016.25	0.156	0.231	0.329	0.453	0.605	0.779	0.971	1.174
2016.33	0.156	0.231	0.329	0.454	0.605	0.780	0.972	1.175
2016.42	0.156	0.231	0.329	0.453	0.605	0.780	0.972	1.175
2016.50	0.155	0.231	0.329	0.453	0.605	0.779	0.972	1.175
2016.58	0.155	0.231	0.329	0.453	0.604	0.779	0.971	1.174
2016.67	0.155	0.231	0.328	0.452	0.604	0.778	0.970	1.173
2016.75	0.156	0.231	0.329	0.453	0.604	0.779	0.971	1.173
2016.83	0.156	0.231	0.329	0.453	0.603	0.778	0.970	1.173
2016.92	0.155	0.231	0.329	0.453	0.604	0.778	0.970	1.173
2017.00	0.155	0.231	0.329	0.453	0.604	0.778	0.971	1.173
2017.08	0.155	0.230	0.329	0.453	0.604	0.778	0.970	1.172

2017.17	0.155	0.230	0.328	0.453	0.604	0.778	0.970	1.173
2017.25	0.154	0.230	0.328	0.453	0.604	0.779	0.971	1.173
2017.33	0.154	0.229	0.328	0.453	0.605	0.779	0.971	1.173
2017.42	0.154	0.230	0.329	0.454	0.605	0.780	0.971	1.173
2017.50	0.154	0.230	0.329	0.455	0.607	0.781	0.972	1.174
2017.58	0.154	0.230	0.330	0.456	0.608	0.782	0.973	1.174
2017.67	0.154	0.231	0.331	0.457	0.608	0.782	0.973	1.174
2017.75	0.155	0.232	0.332	0.458	0.610	0.784	0.974	1.176
2017.83	0.155	0.232	0.333	0.460	0.612	0.785	0.976	1.177
2017.92	0.155	0.233	0.334	0.460	0.612	0.785	0.976	1.177
2018.00	0.156	0.234	0.335	0.461	0.613	0.786	0.976	1.177
2018.08	0.157	0.235	0.336	0.463	0.614	0.787	0.978	1.179
2018.17	0.157	0.236	0.337	0.464	0.615	0.788	0.979	1.180
2018.25	0.158	0.236	0.338	0.464	0.615	0.788	0.978	1.179
2018.33	0.158	0.237	0.339	0.464	0.615	0.787	0.977	1.179
2018.42	0.159	0.237	0.339	0.464	0.615	0.787	0.977	1.178
2018.50	0.158	0.237	0.338	0.463	0.612	0.784	0.974	1.175
2018.58	0.158	0.236	0.337	0.461	0.611	0.783	0.972	1.173
2018.67	0.159	0.236	0.337	0.461	0.611	0.783	0.973	1.173
2018.75	0.159	0.236	0.336	0.460	0.609	0.781	0.971	1.171
2018.83	0.158	0.236	0.335	0.458	0.607	0.779	0.969	1.170
2018.92	0.158	0.235	0.334	0.457	0.606	0.778	0.969	1.170
2019.00	0.158	0.235	0.333	0.456	0.606	0.778	0.968	1.169
2019.08	0.157	0.234	0.332	0.455	0.604	0.776	0.966	1.167
2019.17	0.157	0.233	0.331	0.454	0.604	0.776	0.966	1.167
2019.25	0.156	0.231	0.329	0.453	0.602	0.775	0.966	1.166
2019.33	0.155	0.231	0.329	0.452	0.603	0.776	0.967	1.167
2019.42	0.155	0.230	0.328	0.452	0.603	0.777	0.967	1.168
2019.50	0.155	0.230	0.328	0.453	0.604	0.778	0.969	1.170
2019.58	0.155	0.230	0.328	0.453	0.605	0.779	0.970	1.171
2019.67	0.154	0.230	0.328	0.453	0.605	0.779	0.970	1.171
2019.75	0.154	0.230	0.329	0.454	0.606	0.780	0.971	1.172
2019.83	0.154	0.229	0.329	0.455	0.607	0.781	0.972	1.173
2019.92	0.154	0.230	0.329	0.455	0.608	0.782	0.972	1.173
2020.00	0.154	0.230	0.329	0.455	0.608	0.782	0.972	1.173
2020.08	0.154	0.230	0.330	0.456	0.608	0.781	0.972	1.172
2020.17	0.154	0.230	0.330	0.456	0.607	0.781	0.971	1.172
2020.25	0.155	0.231	0.332	0.457	0.609	0.782	0.972	1.173
2020.33	0.155	0.232	0.332	0.458	0.608	0.781	0.971	1.172
2020.42	0.156	0.233	0.333	0.458	0.608	0.781	0.971	1.171
2020.50	0.156	0.233	0.333	0.458	0.609	0.781	0.971	1.171
2020.58	0.156	0.233	0.333	0.458	0.608	0.780	0.970	1.170
2020.67	0.156	0.233	0.333	0.459	0.609	0.781	0.971	1.172
2020.75	0.156	0.233	0.334	0.459	0.610	0.782	0.972	1.172
2020.83	0.156	0.233	0.334	0.459	0.610	0.782	0.972	1.172
2020.92	0.156	0.233	0.334	0.459	0.610	0.782	0.972	1.172
2021.00	0.156	0.233	0.334	0.459	0.610	0.783	0.972	1.173
2021.08	0.156	0.234	0.334	0.460	0.611	0.783	0.973	1.174
2021.17	0.157	0.234	0.335	0.461	0.612	0.784	0.974	1.174
2021.25	0.157	0.234	0.335	0.461	0.612	0.784	0.974	1.174
2021.33	0.157	0.234	0.335	0.461	0.612	0.784	0.974	1.174
2021.42	0.157	0.234	0.335	0.461	0.612	0.783	0.973	1.173
2021.50	0.157	0.235	0.335	0.461	0.611	0.783	0.973	1.173

Table S3.

year	f-N ₂ O 30S-30N (ppb)						
	fig 1F						
	32 hPa	22 hPa	15 hPa	10 hPa	6.8 hPa	4.6 hPa	3.2 hPa
2005.08	209.19	203.02	196.73	163.04	119.83	78.55	47.37
2005.17	209.30	202.90	197.61	163.83	118.97	77.17	47.20
2005.25	209.53	202.84	198.29	164.44	118.00	75.29	46.34
2005.33	210.19	203.06	198.64	164.67	116.99	73.36	45.12
2005.42	210.93	203.63	199.30	164.96	116.25	71.88	43.89
2005.50	211.78	204.24	199.80	165.25	116.48	72.45	44.72
2005.58	212.87	204.81	199.93	165.33	117.16	74.19	47.06
2005.67	214.05	205.29	199.55	164.47	116.87	75.31	49.26
2005.75	215.03	205.43	198.20	162.12	115.07	75.17	50.48
2005.83	216.01	205.67	196.80	159.30	112.59	74.39	51.05
2005.92	216.89	205.97	195.42	156.28	109.81	73.27	51.23
2006.00	217.68	206.34	194.12	153.47	107.20	71.93	50.87
2006.08	218.10	206.40	192.79	151.46	105.56	70.59	49.67
2006.17	218.21	206.21	191.61	150.28	104.91	69.46	47.79
2006.25	218.25	205.85	190.38	149.52	105.24	69.35	46.34
2006.33	218.06	205.31	189.33	148.94	105.75	69.85	45.80
2006.42	217.48	204.58	188.34	148.47	106.29	70.64	45.99
2006.50	217.04	204.33	188.12	148.37	106.18	70.00	44.88
2006.58	216.46	204.26	188.69	149.11	106.30	68.83	42.75
2006.67	215.84	204.38	189.93	150.80	107.29	68.30	40.91
2006.75	215.23	204.73	192.06	153.87	109.56	68.86	40.05
2006.83	214.40	204.79	194.07	157.19	112.22	69.78	39.79
2006.92	213.76	204.92	195.97	160.50	115.00	70.90	39.76
2007.00	213.37	205.02	197.43	163.09	117.37	72.20	40.15
2007.08	213.39	205.48	198.78	164.54	118.60	73.49	41.36
2007.17	213.76	206.55	200.19	164.97	118.49	74.40	43.25
2007.25	214.34	207.90	201.78	164.89	117.02	73.99	44.68
2007.33	214.92	209.30	203.48	165.09	115.59	73.00	45.28
2007.42	215.61	210.61	204.94	165.38	114.33	71.49	44.75
2007.50	216.19	211.27	205.28	165.22	113.88	71.07	44.42
2007.58	216.71	211.46	204.55	164.18	113.64	72.03	45.80
2007.67	217.35	211.55	203.51	162.86	113.35	73.32	48.23
2007.75	218.09	211.54	202.09	160.78	112.17	73.92	50.30
2007.83	219.00	211.66	200.54	158.17	110.35	73.99	51.69
2007.92	219.86	211.79	198.97	155.31	108.17	73.62	52.47
2008.00	220.42	212.09	197.81	152.87	106.21	73.09	52.80
2008.08	220.63	212.09	196.70	151.25	105.03	72.37	52.13
2008.17	220.48	211.43	195.63	150.63	104.75	71.54	50.52
2008.25	220.00	210.44	194.71	150.88	105.62	71.40	49.01
2008.33	219.51	209.39	193.77	151.41	107.39	72.54	48.53
2008.42	219.00	208.40	192.98	151.90	109.24	74.28	49.04
2008.50	218.32	207.76	192.96	152.73	110.46	75.19	49.46
2008.58	217.40	207.31	193.91	154.33	111.26	74.61	48.24
2008.67	216.36	206.75	195.29	156.63	112.43	73.73	45.85
2008.75	214.87	206.00	196.61	158.97	113.58	72.59	43.09
2008.83	213.28	205.11	197.87	161.60	115.25	72.01	41.08
2008.92	211.93	204.18	199.01	164.45	117.49	72.26	40.00
2009.00	210.94	203.34	200.10	167.28	119.85	72.84	39.43
2009.08	210.39	202.98	201.03	169.17	121.25	73.21	39.36
2009.17	210.16	203.16	201.70	169.74	121.37	73.25	39.75
2009.25	210.19	203.79	202.42	169.47	120.35	72.76	40.26
2009.33	210.23	204.62	203.38	169.00	118.42	71.10	39.89
2009.42	210.25	205.46	204.57	169.04	117.04	69.57	39.16
2009.50	210.48	206.08	205.64	169.41	116.59	69.39	39.63
2009.58	211.01	206.81	206.29	169.24	115.86	69.34	40.64
2009.67	211.78	207.73	206.60	168.68	114.80	68.98	41.64
2009.75	212.88	208.86	207.04	168.24	113.68	68.30	42.15
2009.83	214.12	210.12	207.68	168.05	112.68	67.42	42.09
2009.92	215.29	211.39	208.16	167.63	111.72	66.46	41.55
2010.00	216.40	212.64	208.20	166.57	110.51	65.63	41.15
2010.08	217.26	213.51	208.03	165.44	109.67	65.74	41.72
2010.17	218.01	214.20	208.02	164.84	109.64	66.91	43.41
2010.25	218.52	214.39	207.57	164.04	109.44	67.72	44.76
2010.33	218.81	214.16	206.70	163.07	109.13	68.37	46.05
2010.42	218.84	213.65	205.50	161.89	108.62	68.78	47.08
2010.50	218.76	213.36	204.55	161.32	108.96	69.34	47.23
2010.58	218.53	212.98	203.98	161.73	110.69	71.38	48.33
2010.67	217.62	212.11	203.53	162.46	112.67	73.64	50.01
2010.75	216.55	211.02	203.17	163.58	115.25	76.47	52.07

2010.83	215.28	209.69	202.88	164.72	117.60	78.77	53.33
2010.92	213.87	208.29	202.86	166.02	119.58	80.76	54.79
2011.00	212.45	206.76	202.83	167.27	121.11	82.16	55.92
2011.08	211.34	205.49	202.82	168.31	122.00	82.49	56.02
2011.17	210.40	204.50	202.74	169.09	122.40	81.96	55.07
2011.25	209.62	203.97	202.94	169.96	122.93	81.50	54.08
2011.33	208.84	203.60	203.33	170.77	123.34	81.07	53.01
2011.42	208.21	203.42	203.99	171.76	123.82	80.77	52.15
2011.50	207.62	203.14	204.51	171.99	122.96	79.44	51.21
2011.58	207.37	202.96	204.94	171.93	121.58	77.45	49.78
2011.67	207.66	203.30	205.22	171.19	119.58	74.92	47.45
2011.75	208.04	203.98	205.52	170.35	117.55	72.42	45.38
2011.83	208.68	205.06	205.66	169.31	115.92	70.91	44.46
2011.92	209.36	206.25	205.50	167.81	114.27	69.58	43.41
2012.00	209.93	207.37	205.28	166.29	112.81	68.63	42.69
2012.08	210.34	208.31	205.17	165.17	111.87	68.31	42.71
2012.17	210.83	209.02	205.12	164.37	111.30	68.41	43.19
2012.25	211.43	209.47	204.88	163.58	110.88	68.71	43.82
2012.33	212.29	209.99	204.46	162.61	110.34	68.90	44.37
2012.42	213.25	210.57	203.96	161.18	108.93	68.20	44.40
2012.50	214.21	210.88	203.02	159.65	107.53	67.15	43.75
2012.58	215.17	211.05	201.71	158.41	107.61	67.74	43.79
2012.67	216.04	210.78	199.67	156.72	108.02	69.32	45.00
2012.75	217.03	210.42	197.30	154.31	107.81	70.97	46.66
2012.83	217.82	210.05	195.24	151.70	106.70	71.91	48.22
2012.92	218.78	209.95	193.86	149.65	105.31	72.12	49.44
2013.00	219.58	209.91	193.02	148.29	104.10	71.85	49.98
2013.08	220.18	209.84	192.43	147.77	103.99	71.89	49.79
2013.17	220.45	209.59	191.84	147.84	105.03	72.96	49.93
2013.25	220.50	209.25	191.40	148.43	107.02	75.17	51.00
2013.33	220.23	208.63	190.87	149.20	109.44	77.97	52.69
2013.42	219.90	207.89	190.24	150.08	112.19	81.07	54.61
2013.50	219.27	207.20	189.76	150.61	113.99	83.22	56.15
2013.58	218.27	206.74	190.01	150.92	113.64	82.38	55.43
2013.67	217.09	206.48	191.17	152.24	113.80	81.52	54.29
2013.75	215.91	206.13	192.68	154.48	115.16	81.66	53.74
2013.83	214.82	205.77	194.07	157.14	117.50	82.64	53.61
2013.92	213.56	205.13	194.94	159.64	120.26	84.06	53.67
2014.00	212.47	204.62	195.65	161.83	122.83	85.53	53.93
2014.08	211.55	204.45	196.57	163.53	124.22	86.19	54.37
2014.17	210.71	204.41	197.68	164.99	124.68	85.74	54.22
2014.25	210.12	204.63	198.83	166.22	124.57	84.38	53.15
2014.33	209.70	205.23	200.31	167.54	124.37	82.79	51.65
2014.42	209.28	206.01	202.02	168.81	124.20	81.55	50.43
2014.50	209.11	206.95	203.92	170.29	124.62	81.55	50.76
2014.58	209.33	207.80	205.20	171.04	124.84	82.19	52.25
2014.67	209.60	208.81	206.21	170.94	123.98	81.99	53.32
2014.75	209.87	209.90	206.91	170.02	121.83	80.28	52.97
2014.83	210.42	211.08	207.65	169.07	119.29	77.89	52.03
2014.92	211.14	212.17	208.35	168.24	116.93	75.45	50.68
2015.00	211.90	212.69	208.30	167.52	115.78	74.17	49.66
2015.08	212.62	212.63	207.22	166.55	115.77	74.32	49.17
2015.17	213.22	212.31	205.42	164.76	115.61	75.07	49.20
2015.25	213.43	211.79	203.36	162.35	114.93	76.07	50.04
2015.33	213.44	211.24	201.28	159.66	113.72	76.84	51.31
2015.42	213.19	210.60	199.42	157.39	112.47	77.07	52.19
2015.50	212.77	210.01	198.27	156.33	111.82	76.46	51.34
2015.58	212.00	209.17	197.60	156.52	112.29	75.92	49.52
2015.67	211.49	208.13	197.04	157.76	114.55	77.00	48.51
2015.75	211.43	207.01	196.42	159.62	118.28	79.99	49.27
2015.83	211.30	205.66	195.19	160.92	121.94	83.19	50.37
2015.92	211.11	204.38	193.75	161.57	124.88	86.23	51.90
2016.00	210.77	203.47	192.81	161.80	126.56	88.26	53.34
2016.08	210.40	202.95	192.59	161.81	126.84	88.98	54.37
2016.17	210.05	202.66	192.96	162.15	126.87	89.31	55.24
2016.25	209.80	202.26	193.47	162.92	127.18	89.44	55.69
2016.33	209.77	201.69	193.67	163.64	127.58	89.36	55.52
2016.42	210.09	201.16	193.63	164.18	128.20	89.73	55.67
2016.50	210.45	200.80	193.25	164.05	128.59	90.44	56.24
2016.58	210.66	200.70	192.88	163.65	128.71	91.15	57.11
2016.67	210.76	200.87	192.77	163.24	128.51	91.51	57.94
2016.75	210.36	201.18	192.96	162.75	127.82	91.26	58.39
2016.83	209.51	201.38	193.68	162.73	127.31	91.35	59.17
2016.92	208.51	201.51	194.71	163.20	127.16	91.48	59.68

2017.00	207.56	201.72	195.87	164.04	127.28	91.47	59.80
2017.08	206.87	202.08	197.16	165.46	128.02	91.52	59.64
2017.17	206.44	202.57	198.47	167.18	129.27	91.70	59.26
2017.25	206.12	203.32	199.88	169.03	130.66	91.79	58.53
2017.33	205.74	204.36	201.68	171.02	131.88	91.67	57.74
2017.42	205.23	205.54	203.68	172.74	132.55	91.29	56.99
2017.50	204.74	206.61	205.56	173.83	132.35	90.60	56.62
2017.58	204.33	207.62	207.24	174.23	131.14	89.44	56.63
2017.67	204.17	208.35	208.53	174.24	129.31	87.50	56.10
2017.75	204.16	208.95	209.63	174.10	127.04	84.57	54.30
2017.83	204.40	209.84	210.69	173.77	124.50	81.02	51.65
2017.92	204.90	210.91	211.63	173.49	122.47	78.09	49.31
2018.00	205.51	212.01	212.29	172.72	120.46	75.91	47.77
2018.08	205.85	212.88	212.51	171.16	117.99	74.08	46.84
2018.17	206.22	213.74	212.56	169.16	115.09	72.13	46.13
2018.25	206.79	214.65	212.70	167.19	112.07	70.21	45.78
2018.33	207.40	215.10	212.46	165.31	109.37	68.49	45.55
2018.42	207.96	214.96	211.84	163.95	107.45	66.94	44.97
2018.50	208.72	214.55	211.14	163.77	107.78	67.39	45.26
2018.58	209.66	214.10	210.12	163.97	109.96	70.17	47.12
2018.67	210.14	213.33	208.32	163.46	112.01	73.08	49.09
2018.75	210.34	212.39	206.26	162.55	113.85	76.41	51.84
2018.83	210.53	211.33	204.32	161.95	116.21	80.49	55.16
2018.92	210.63	210.21	202.60	161.65	118.37	83.99	58.10
2019.00	210.79	209.32	201.42	161.89	120.29	86.45	60.10
2019.08	210.89	208.68	200.97	162.81	122.16	88.08	61.13
2019.17	210.75	208.23	201.22	164.38	124.04	89.06	61.23
2019.25	210.68	207.84	201.90	166.79	126.76	90.38	61.13
2019.33	210.56	207.68	202.79	169.52	129.84	91.90	61.07
2019.42	210.56	207.92	203.56	171.46	132.19	93.41	61.51
2019.50	210.22	208.38	204.23	172.30	132.94	93.80	61.78
2019.58	209.48	208.83	205.22	173.01	132.47	92.28	60.46
2019.67	208.58	209.61	207.03	174.27	132.21	90.81	58.71
2019.75	207.74	210.34	209.14	176.05	132.37	89.33	56.55
2019.83	207.15	210.94	211.24	178.01	132.32	87.43	54.34
2019.92	206.84	211.45	213.01	179.48	132.04	85.85	52.68
2020.00	206.55	211.77	214.30	180.28	131.53	84.81	51.91
2020.08	206.24	211.82	214.80	180.21	130.82	84.34	51.93
2020.17	205.92	211.69	214.79	179.62	130.11	84.56	52.83
2020.25	205.38	211.25	214.16	178.24	128.58	84.15	53.57
2020.33	204.91	210.72	213.30	176.62	126.77	83.33	53.90
2020.42	204.24	210.05	212.51	175.53	125.56	82.47	53.64
2020.50	203.76	209.58	212.07	174.96	124.71	81.45	52.62
2020.58	203.65	209.33	212.21	175.31	124.88	81.30	51.93
2020.67	203.52	208.97	212.44	175.87	125.02	80.90	51.23
2020.75	203.39	208.67	212.42	176.00	124.79	80.17	50.35
2020.83	202.93	208.38	212.21	175.81	124.62	79.78	49.82
2020.92	202.28	208.21	212.20	175.77	124.58	79.68	49.61
2021.00	201.42	207.95	212.31	175.94	124.64	79.44	49.12
2021.08	200.92	208.05	212.65	176.32	124.63	78.78	48.26
2021.17	200.61	208.18	212.88	176.50	124.20	77.57	47.08
2021.25	200.34	208.62	213.24	176.34	123.39	76.18	45.78
2021.33	200.06	209.29	213.79	176.13	122.69	75.16	44.69
2021.42	200.06	210.14	214.50	176.11	122.41	74.84	44.18
2021.50	200.08	210.68	214.73	175.64	122.18	75.40	45.07

Table S4.

year	f-N ₂ O 30N-58N (ppb)						
no figure							
pressure	32 hPa	22 hPa	15 hPa	10 hPa	6.8 hPa	4.6 hPa	3.2 hPa
2005.08	140.94	131.71	112.79	76.69	48.41	31.91	21.18
2005.17	139.81	131.22	114.28	79.30	50.45	32.92	21.61
2005.25	138.73	130.53	115.31	81.54	52.64	34.44	22.54
2005.33	138.25	130.05	115.93	83.31	54.69	35.96	23.34
2005.42	137.58	129.74	116.79	84.94	55.74	35.96	22.92
2005.50	136.92	129.71	116.92	84.01	53.76	34.26	22.33
2005.58	136.98	129.55	115.38	81.18	51.27	33.35	22.67
2005.67	138.18	129.58	113.49	78.25	48.99	32.61	23.06
2005.75	140.82	130.87	112.42	75.52	46.50	31.38	22.85
2005.83	143.67	132.51	111.72	73.26	44.46	30.32	22.46
2005.92	146.07	133.86	111.04	71.13	42.51	29.33	22.16
2006.00	148.42	135.52	110.92	69.52	40.74	28.33	21.85
2006.08	150.55	137.31	111.16	68.24	39.01	27.14	21.33
2006.17	152.56	139.31	111.85	67.42	37.46	25.78	20.51
2006.25	154.56	141.32	112.68	66.96	36.18	24.36	19.40
2006.33	156.25	143.21	113.66	66.58	34.86	22.93	18.40
2006.42	158.26	145.21	114.42	65.96	34.01	22.69	18.55
2006.50	159.62	145.78	114.77	67.27	36.14	24.36	19.09
2006.58	159.73	145.99	116.50	70.19	38.46	24.99	18.49
2006.67	158.30	145.87	118.56	73.13	40.57	25.60	18.11
2006.75	156.11	144.99	119.74	75.57	42.70	26.65	18.29
2006.83	153.77	143.92	120.99	78.08	44.63	27.53	18.62
2006.92	151.26	142.62	121.91	80.32	46.51	28.39	18.86
2007.00	149.05	141.39	122.44	82.04	48.17	29.24	19.08
2007.08	146.90	139.92	122.64	83.51	49.80	30.30	19.54
2007.17	144.93	138.25	122.27	84.38	51.17	31.48	20.27
2007.25	143.04	136.61	121.77	84.89	52.25	32.65	21.18
2007.33	141.47	135.21	121.23	85.29	53.24	33.70	22.01
2007.42	139.72	133.93	120.85	85.66	53.75	33.85	21.89
2007.50	138.91	134.23	121.50	85.49	52.69	32.79	21.42
2007.58	139.85	135.28	120.76	83.53	51.23	32.55	21.89
2007.67	141.34	135.21	118.46	80.82	49.70	32.44	22.56
2007.75	142.50	134.54	115.89	78.04	48.07	32.10	22.97
2007.83	143.55	134.12	113.35	75.08	46.36	31.66	22.99
2007.92	145.20	134.39	111.31	72.32	44.62	31.15	22.97
2008.00	146.57	134.68	109.73	69.93	42.90	30.51	22.91
2008.08	147.93	135.29	108.52	67.66	41.02	29.56	22.58
2008.17	149.25	136.12	107.82	65.80	39.15	28.33	21.93
2008.25	150.50	136.97	107.41	64.38	37.45	26.89	20.90
2008.33	151.55	137.80	107.36	63.32	35.87	25.41	19.84
2008.42	152.41	138.28	106.98	62.30	35.04	25.19	19.98
2008.50	152.44	137.38	105.63	61.74	35.69	26.19	20.48
2008.58	150.73	135.32	105.63	63.91	38.00	27.15	20.31
2008.67	147.93	134.17	107.78	67.50	40.50	27.67	19.55
2008.75	146.18	134.52	111.33	71.59	42.54	27.41	18.31
2008.83	144.76	135.05	114.93	75.63	44.53	27.42	17.72
2008.92	143.27	135.01	117.83	79.36	46.65	27.81	17.52
2009.00	141.82	134.42	119.91	82.71	48.94	28.51	17.48
2009.08	140.47	133.44	121.07	85.41	51.28	29.62	17.74

2009.17	139.20	132.29	121.54	87.43	53.48	31.02	18.33
2009.25	138.11	131.17	121.57	88.78	55.37	32.64	19.41
2009.33	137.22	130.12	121.22	89.62	57.03	34.35	20.64
2009.42	136.28	128.80	120.60	90.07	57.75	34.59	20.47
2009.50	135.10	128.26	121.34	90.59	56.69	32.84	19.37
2009.58	134.75	128.82	121.78	89.37	54.44	31.32	19.13
2009.67	135.41	130.12	122.28	88.57	53.05	30.60	19.47
2009.75	136.47	131.24	122.52	88.19	52.52	30.47	19.89
2009.83	137.53	132.09	122.54	87.96	52.30	30.39	20.01
2009.92	138.54	133.15	122.82	87.98	52.34	30.36	19.92
2010.00	139.34	134.46	123.38	88.13	52.49	30.51	19.97
2010.08	140.00	135.82	124.28	88.51	52.74	30.76	20.16
2010.17	140.57	137.26	125.46	89.12	53.09	31.11	20.51
2010.25	141.06	138.74	126.86	89.92	53.46	31.34	20.71
2010.33	141.56	140.17	128.31	90.58	53.32	30.93	20.46
2010.42	142.51	141.89	129.48	90.42	52.54	30.56	20.75
2010.50	143.33	141.56	127.30	88.49	52.67	32.06	22.14
2010.58	142.56	138.89	124.44	87.66	53.79	33.58	23.03
2010.67	140.85	135.37	121.40	86.61	54.66	35.08	24.18
2010.75	138.00	131.32	117.93	85.04	55.10	36.50	25.62
2010.83	134.17	127.18	115.31	84.31	55.72	37.44	26.29
2010.92	130.75	123.28	112.76	83.40	55.97	38.10	26.85
2011.00	127.93	119.62	109.97	81.95	55.58	38.22	27.10
2011.08	125.58	116.14	107.04	80.25	54.88	37.98	27.01
2011.17	123.48	112.81	104.01	78.33	53.94	37.55	26.74
2011.25	121.31	109.55	100.99	76.32	52.87	37.02	26.47
2011.33	119.31	106.49	97.94	74.40	52.28	37.11	26.57
2011.42	117.54	103.99	95.92	74.17	53.43	38.28	26.94
2011.50	116.27	103.14	96.83	76.08	54.67	38.37	26.45
2011.58	115.87	104.93	99.55	77.46	54.27	37.27	25.52
2011.67	116.69	108.02	102.33	78.01	53.08	35.60	23.98
2011.75	118.00	110.77	104.39	78.43	52.26	34.23	22.52
2011.83	119.91	113.39	105.60	77.98	51.17	33.28	21.80
2011.92	121.46	115.75	106.77	77.61	50.22	32.48	21.23
2012.00	122.46	117.71	108.09	77.71	49.69	31.96	20.89
2012.08	123.13	119.51	109.60	78.18	49.48	31.68	20.76
2012.17	123.72	121.05	111.10	78.91	49.53	31.47	20.60
2012.25	124.33	122.28	112.47	79.84	49.92	31.50	20.46
2012.33	124.64	123.39	114.06	81.14	50.45	31.42	20.28
2012.42	124.94	124.92	116.32	82.58	50.44	30.64	19.62
2012.50	126.02	127.04	117.76	82.39	49.35	29.70	19.20
2012.58	128.26	127.90	116.26	80.20	48.17	29.52	19.32
2012.67	130.89	127.52	113.23	77.57	47.25	29.48	19.34
2012.75	133.27	126.61	110.08	75.18	46.88	30.43	20.51
2012.83	135.88	125.93	107.23	73.08	46.49	31.04	21.36
2012.92	138.34	125.39	104.42	70.65	45.52	31.03	21.70
2013.00	140.93	125.57	102.18	68.32	44.44	30.89	21.85
2013.08	143.52	126.29	100.62	66.21	43.14	30.44	21.76
2013.17	145.84	127.41	99.77	64.48	41.75	29.73	21.45
2013.25	148.09	128.75	99.46	63.18	40.37	28.72	20.83
2013.33	150.04	129.92	99.29	61.99	38.97	27.73	20.35
2013.42	151.30	130.27	98.42	60.53	37.92	27.60	20.84
2013.50	151.92	130.44	98.50	61.12	39.17	28.97	21.80
2013.58	151.38	130.41	100.14	64.09	41.95	30.52	22.25

2013.67	149.48	130.51	103.26	68.06	44.58	31.61	22.57
2013.75	147.38	131.42	107.06	71.50	45.83	31.28	21.83
2013.83	144.96	131.88	110.03	74.05	46.80	31.37	21.68
2013.92	142.37	131.97	112.71	76.75	48.17	31.77	21.71
2014.00	139.87	131.66	114.93	79.35	49.63	32.17	21.68
2014.08	137.38	130.94	116.52	81.69	51.25	32.80	21.80
2014.17	135.06	129.92	117.45	83.54	52.77	33.60	22.13
2014.25	132.90	128.87	117.91	84.73	53.92	34.45	22.70
2014.33	131.15	127.98	117.97	85.45	54.94	35.36	23.26
2014.42	129.67	126.94	117.64	85.98	55.78	35.61	22.79
2014.50	128.10	125.69	117.17	85.67	54.69	33.98	21.56
2014.58	126.95	125.78	117.71	84.84	52.65	32.45	21.39
2014.67	127.29	126.88	117.72	82.94	50.37	31.56	21.97
2014.75	128.14	128.13	118.07	82.12	49.27	31.07	22.18
2014.83	128.37	129.03	118.96	82.44	48.78	30.26	21.67
2014.92	128.78	129.93	119.84	82.94	48.68	29.82	21.32
2015.00	129.25	130.88	120.70	83.42	48.74	29.68	21.21
2015.08	129.71	131.64	121.31	83.79	48.86	29.62	21.09
2015.17	130.10	132.19	121.68	84.03	49.03	29.61	20.95
2015.25	130.49	132.84	122.14	84.42	49.35	29.71	20.86
2015.33	130.90	133.59	122.88	84.97	49.55	29.59	20.65
2015.42	131.59	134.66	123.80	85.13	49.23	29.61	21.19
2015.50	132.11	134.96	123.38	84.75	49.99	31.24	22.64
2015.58	132.18	134.12	122.38	85.27	51.85	32.76	22.89
2015.67	130.74	132.11	121.82	87.05	54.34	33.96	22.44
2015.75	128.13	129.38	120.64	87.70	55.80	34.87	22.31
2015.83	126.52	127.97	120.08	88.24	57.07	35.91	22.55
2015.92	125.21	126.79	119.67	88.67	57.96	36.60	22.73
2016.00	124.03	125.45	119.07	88.88	58.61	37.20	22.99
2016.08	122.92	124.18	118.49	88.95	59.04	37.71	23.37
2016.17	122.05	123.18	118.08	89.06	59.48	38.32	23.94
2016.25	121.27	122.25	117.60	88.93	59.62	38.72	24.49
2016.33	120.58	121.46	117.15	88.75	59.64	38.97	24.83
2016.42	119.87	120.24	115.96	87.90	59.29	38.94	24.75
2016.50	118.71	119.22	115.62	88.10	59.60	38.92	24.37
2016.58	117.63	118.53	115.44	87.96	59.38	38.79	24.45
2016.67	116.86	117.89	114.98	87.71	59.22	38.67	24.50
2016.75	116.67	117.50	114.40	87.32	59.02	38.56	24.57
2016.83	116.42	116.76	113.38	86.39	58.54	38.52	24.80
2016.92	116.02	116.01	112.48	85.66	58.22	38.58	25.01
2017.00	115.46	115.33	111.61	84.88	57.80	38.48	25.05
2017.08	114.80	114.66	110.86	84.20	57.34	38.32	25.07
2017.17	114.10	113.99	110.21	83.61	56.85	37.99	24.91
2017.25	113.19	113.16	109.56	83.17	56.50	37.71	24.73
2017.33	112.00	112.13	108.76	82.74	56.48	37.94	24.97
2017.42	110.91	111.49	108.74	83.56	57.72	38.79	25.16
2017.50	110.29	111.35	109.40	84.56	58.22	38.64	24.79
2017.58	110.28	112.76	111.50	85.76	57.91	37.78	24.35
2017.67	111.16	115.07	113.60	86.06	56.83	36.90	24.37
2017.75	112.85	118.72	117.11	87.49	56.35	36.01	24.01
2017.83	114.57	122.04	120.30	89.05	56.15	35.13	23.34
2017.92	116.33	125.26	123.16	90.43	56.13	34.57	22.90
2018.00	117.88	128.20	125.97	92.04	56.48	34.30	22.61
2018.08	119.16	130.90	128.66	93.75	57.13	34.28	22.43

2018.17	120.35	133.48	131.33	95.62	58.17	34.71	22.50
2018.25	121.76	135.96	133.87	97.51	59.36	35.35	22.74
2018.33	123.46	138.52	136.57	99.58	60.50	35.63	22.57
2018.42	125.55	141.47	139.08	100.48	59.89	34.64	22.08
2018.50	127.94	143.32	138.97	98.48	57.55	33.37	21.95
2018.58	129.77	141.78	134.74	94.13	55.34	33.14	22.28
2018.67	130.84	138.26	129.41	91.08	55.54	34.47	23.07
2018.75	130.64	133.30	123.82	88.90	56.50	36.21	24.42
2018.83	129.90	127.93	118.08	86.42	57.19	38.12	26.23
2018.92	128.98	122.66	112.12	83.33	57.15	39.50	27.70
2019.00	128.64	118.45	106.63	79.81	56.38	40.30	28.85
2019.08	128.93	115.17	101.71	76.18	55.09	40.52	29.50
2019.17	129.37	112.51	97.16	72.21	53.00	39.97	29.63
2019.25	129.66	110.37	93.52	68.75	50.73	38.91	29.32
2019.33	129.52	108.34	90.26	65.53	48.52	37.91	29.14
2019.42	128.57	106.25	87.94	64.16	48.58	38.74	29.80
2019.50	126.72	104.70	87.82	65.54	50.16	39.41	29.78
2019.58	125.29	105.70	90.98	69.00	51.98	39.65	29.77
2019.67	124.26	108.51	95.22	71.23	51.78	38.75	29.34
2019.75	123.96	111.66	98.68	72.59	51.96	38.75	29.02
2019.83	123.67	114.77	102.55	75.04	53.22	39.38	28.90
2019.92	123.34	117.80	106.51	77.64	54.47	39.82	28.74
2020.00	122.62	120.25	110.16	80.23	55.75	40.29	28.66
2020.08	121.51	122.16	113.54	82.81	57.03	40.79	28.77
2020.17	120.23	123.58	116.66	85.51	58.52	41.45	29.04
2020.25	119.01	124.61	119.05	87.74	60.01	42.29	29.48
2020.33	118.03	125.41	120.89	89.50	61.23	43.00	29.78
2020.42	117.77	126.34	122.07	89.99	60.94	42.41	29.38
2020.50	118.26	127.40	122.63	89.58	60.30	42.27	29.51
2020.58	117.82	126.46	121.26	88.67	60.32	42.54	29.28
2020.67	117.47	126.14	121.11	88.82	60.54	42.38	28.56
2020.75	117.03	126.13	121.80	89.41	60.13	41.16	27.34
2020.83	117.00	126.72	122.50	89.23	58.87	39.54	26.23
2020.92	116.94	127.21	123.26	89.20	57.87	38.40	25.58
2021.00	116.51	127.22	123.82	89.53	57.40	37.62	25.10
2021.08	116.19	127.01	124.01	89.77	57.20	37.08	24.66
2021.17	116.01	126.72	123.97	90.01	57.31	36.87	24.33
2021.25	115.70	126.29	123.75	90.13	57.52	36.96	24.29
2021.33	115.50	125.75	123.29	90.15	57.89	37.18	24.19
2021.42	114.76	124.68	123.01	90.89	58.52	37.06	23.71
2021.50	114.02	124.22	123.38	91.10	57.82	36.04	23.12

Table S5.

year	f-N2O 30S-58S (ppb)						
no figure							
pressure	32 hPa	22 hPa	15 hPa	10 hPa	6.8 hPa	4.6 hPa	3.2 hPa
2005.08	131.23	109.32	99.84	79.50	56.59	38.02	24.24
2005.17	129.96	109.84	101.95	80.84	55.99	36.77	23.77
2005.25	129.54	111.23	104.00	81.56	54.90	35.20	23.02
2005.33	129.41	112.64	105.96	82.80	54.58	33.81	21.79
2005.42	129.09	113.96	108.14	84.52	54.98	33.08	20.85
2005.50	128.90	115.31	110.41	86.41	55.83	33.03	20.44
2005.58	128.54	116.36	112.57	88.47	57.08	33.53	20.50
2005.67	128.16	117.30	114.48	90.38	58.38	34.24	20.84
2005.75	127.93	118.21	116.24	92.22	59.71	35.04	21.31
2005.83	127.90	119.54	118.46	94.40	61.24	35.87	21.66
2005.92	128.73	121.43	120.88	95.99	61.36	35.14	20.99
2006.00	130.54	123.72	122.53	95.78	59.65	33.37	19.88
2006.08	133.34	125.64	122.50	94.26	58.22	32.65	19.50
2006.17	135.88	125.92	120.80	92.88	58.30	33.11	19.34
2006.25	137.44	125.12	118.75	91.83	58.71	33.62	19.02
2006.33	138.61	123.80	116.29	90.37	58.95	34.55	19.41
2006.42	139.72	122.87	114.07	88.63	58.86	35.57	20.29
2006.50	140.40	121.82	111.87	86.68	58.20	35.96	20.87
2006.58	141.31	121.12	109.85	84.51	56.92	35.68	21.08
2006.67	142.10	120.63	108.23	82.55	55.54	35.05	20.89
2006.75	142.70	120.13	106.74	80.68	54.09	34.24	20.49
2006.83	143.34	119.38	104.91	78.65	52.53	33.32	20.05
2006.92	143.10	118.08	103.05	77.21	52.03	33.55	20.53
2007.00	141.97	116.71	102.37	77.69	53.28	34.90	21.59
2007.08	139.77	116.00	103.80	80.07	55.16	35.98	22.26
2007.17	137.87	116.79	106.61	81.96	55.11	35.44	22.34
2007.25	136.76	118.97	110.25	83.59	54.30	34.47	22.52
2007.33	136.44	122.03	114.48	85.39	53.06	32.61	21.91
2007.42	136.35	125.01	119.03	88.27	52.85	30.87	20.74
2007.50	136.30	127.57	123.21	91.53	53.63	29.95	19.72
2007.58	135.59	129.32	126.84	94.94	55.29	30.01	19.19
2007.67	135.14	130.98	130.09	98.22	57.40	30.86	19.34
2007.75	134.86	132.66	133.05	101.20	59.54	32.11	19.99
2007.83	134.72	134.33	135.88	103.97	61.58	33.37	20.71
2007.92	135.31	136.41	138.62	106.21	62.76	33.70	20.71
2008.00	136.69	138.29	140.04	106.52	62.30	33.16	20.44
2008.08	138.98	139.53	139.36	104.91	61.26	33.02	20.63
2008.17	141.11	139.75	137.91	103.98	61.88	34.17	21.09
2008.25	142.77	138.86	135.76	103.14	62.86	35.32	21.18
2008.33	143.48	136.77	132.52	101.62	63.71	36.72	21.59
2008.42	144.15	134.87	129.02	99.09	63.53	37.86	22.42
2008.50	145.01	133.77	126.21	96.49	62.62	38.31	23.10
2008.58	145.98	133.12	123.99	93.98	61.15	38.02	23.35
2008.67	146.79	132.49	122.16	91.74	59.42	37.12	23.06
2008.75	147.29	131.65	120.37	89.62	57.63	35.95	22.44
2008.83	147.69	130.88	118.71	87.67	56.02	34.97	21.99
2008.92	147.34	129.53	116.79	86.21	55.65	35.36	22.43
2009.00	146.10	127.59	115.12	85.99	56.82	36.79	23.27
2009.08	144.16	125.62	114.44	87.19	58.83	38.14	23.60
2009.17	142.50	125.12	115.66	89.41	60.46	38.42	23.17

2009.25	141.09	126.24	118.88	92.37	61.49	37.93	22.57
2009.33	140.23	128.41	123.03	95.79	62.56	37.33	21.81
2009.42	138.97	129.96	126.83	99.56	64.55	37.51	21.28
2009.50	137.34	130.12	129.11	102.56	66.74	38.38	21.25
2009.58	136.19	130.25	130.77	104.92	68.69	39.42	21.55
2009.67	135.23	130.45	132.02	106.74	70.33	40.46	22.03
2009.75	134.72	130.85	133.17	108.25	71.70	41.43	22.61
2009.83	134.16	130.94	133.77	109.32	72.99	42.50	23.24
2009.92	133.97	131.21	134.55	110.56	74.04	42.90	23.18
2010.00	134.18	132.28	136.44	112.27	74.61	42.50	22.66
2010.08	135.17	134.71	139.01	113.01	73.39	40.93	21.87
2010.17	136.68	136.86	139.48	110.54	70.02	39.06	21.72
2010.25	138.64	138.15	138.14	106.98	67.00	38.13	22.15
2010.33	140.91	139.18	136.18	102.84	63.56	37.00	22.62
2010.42	143.55	140.89	135.26	99.40	59.82	34.99	22.37
2010.50	145.58	143.11	135.97	97.81	57.10	32.93	21.62
2010.58	146.80	144.74	136.88	97.21	55.51	31.39	20.74
2010.67	147.96	146.23	137.87	97.17	54.78	30.57	20.15
2010.75	148.83	147.66	138.98	97.42	54.46	30.12	19.78
2010.83	149.93	148.99	140.27	98.16	54.56	30.03	19.82
2010.92	151.09	150.50	141.46	98.25	53.96	29.67	19.95
2011.00	152.44	151.70	141.63	97.49	53.31	29.78	20.55
2011.08	152.95	151.45	141.08	97.67	54.50	31.34	21.84
2011.17	152.60	150.47	141.09	99.50	56.91	32.93	22.42
2011.25	151.78	149.30	141.19	101.49	59.22	34.05	22.40
2011.33	150.73	148.26	142.00	104.66	62.77	35.93	22.59
2011.42	148.87	146.18	141.59	106.72	65.95	38.19	23.31
2011.50	147.94	144.59	140.56	107.32	67.80	39.98	24.21
2011.58	147.38	143.46	139.73	107.45	68.82	41.21	25.06
2011.67	146.59	142.23	138.89	107.25	69.15	41.78	25.58
2011.75	145.96	141.13	138.10	107.04	69.36	42.13	25.94
2011.83	145.28	140.30	137.28	106.39	69.05	42.01	25.81
2011.92	144.57	139.47	136.68	106.33	69.27	41.97	25.40
2012.00	143.95	138.94	136.75	106.93	69.61	41.55	24.51
2012.08	143.67	139.25	137.17	106.56	68.31	39.95	23.21
2012.17	143.76	139.71	136.91	105.02	66.34	38.62	22.75
2012.25	144.18	140.42	136.80	103.35	64.26	37.58	22.81
2012.33	144.55	141.42	136.78	101.27	61.52	36.06	22.62
2012.42	144.73	142.74	137.29	99.67	58.83	34.12	21.99
2012.50	144.44	143.93	138.31	99.03	56.94	32.42	21.21
2012.58	144.82	145.11	139.55	99.44	56.19	31.25	20.40
2012.67	145.25	146.04	140.42	99.88	55.88	30.53	19.80
2012.75	145.70	146.72	141.12	100.43	55.93	30.18	19.33
2012.83	145.93	147.21	141.93	101.29	56.30	30.01	19.01
2012.92	146.30	147.69	142.54	101.65	56.06	29.50	18.73
2013.00	146.81	148.04	142.36	100.63	54.58	28.37	18.24
2013.08	147.17	147.20	140.12	98.06	53.12	28.14	18.40
2013.17	147.04	144.82	136.48	95.92	53.43	29.45	19.21
2013.25	145.95	141.07	132.45	94.77	55.04	31.56	20.40
2013.33	144.73	137.10	128.52	93.69	56.48	33.60	21.77
2013.42	144.19	133.32	124.26	91.94	57.21	35.08	22.82
2013.50	143.83	130.05	120.07	89.70	57.35	36.12	23.60
2013.58	143.83	127.71	116.20	86.64	56.35	36.46	24.17
2013.67	143.73	125.67	112.97	83.83	55.02	36.29	24.36

2013.75	143.36	123.80	110.20	81.28	53.51	35.71	24.20
2013.83	142.70	122.05	107.77	78.83	51.74	34.74	23.74
2013.92	141.52	120.26	105.44	76.67	50.81	35.05	24.40
2014.00	140.01	118.30	103.38	75.72	51.55	36.61	25.72
2014.08	138.05	116.59	103.16	77.29	53.47	37.73	26.22
2014.17	136.07	116.13	105.11	79.96	54.74	37.50	25.70
2014.25	134.46	116.91	107.90	82.56	55.60	36.80	24.74
2014.33	132.96	117.94	110.61	85.19	56.90	36.48	23.72
2014.42	131.55	118.94	113.36	88.12	58.92	37.20	23.52
2014.50	130.35	119.53	115.47	90.54	60.79	38.19	23.75
2014.58	128.51	119.35	116.92	92.52	62.50	39.30	24.24
2014.67	126.83	119.17	118.09	94.15	63.93	40.29	24.80
2014.75	125.50	119.10	119.03	95.48	65.21	41.27	25.44
2014.83	124.43	119.02	119.87	96.88	66.66	42.35	26.02
2014.92	123.66	119.34	121.41	98.68	67.53	42.10	25.37
2015.00	123.59	120.89	123.65	99.84	67.08	40.88	24.28
2015.08	125.05	123.25	125.07	99.50	66.01	40.06	23.76
2015.17	127.37	125.45	125.37	98.34	65.06	39.76	23.56
2015.25	130.49	127.33	124.46	96.06	63.59	39.56	23.60
2015.33	133.86	128.63	122.36	92.52	61.36	39.43	24.38
2015.42	137.01	130.33	120.98	89.21	58.62	38.49	24.75
2015.50	139.40	132.10	120.60	86.88	56.15	37.20	24.60
2015.58	141.56	133.63	120.64	85.33	54.06	35.71	23.98
2015.67	143.71	135.12	120.99	84.50	52.60	34.44	23.25
2015.75	145.52	136.38	121.52	84.09	51.52	33.39	22.53
2015.83	147.00	137.32	121.83	83.57	50.55	32.68	22.32
2015.92	148.26	137.87	121.55	83.15	50.92	33.87	23.56
2016.00	149.03	137.44	120.93	83.66	52.48	35.35	24.33
2016.08	148.63	136.27	120.48	84.56	53.82	36.15	24.55
2016.17	147.74	135.00	119.82	84.63	54.31	36.85	25.27
2016.25	146.55	133.85	119.59	84.91	54.83	37.71	26.29
2016.33	145.16	132.70	119.88	85.77	55.29	37.86	26.46
2016.42	143.68	131.23	119.60	86.35	55.78	37.96	26.35
2016.50	143.04	129.95	119.04	86.68	56.23	38.15	26.33
2016.58	142.94	129.37	118.67	86.89	56.67	38.42	26.42
2016.67	142.81	128.97	118.36	86.96	56.99	38.67	26.54
2016.75	142.62	128.58	117.88	86.79	57.08	38.75	26.56
2016.83	142.63	128.38	117.60	86.61	56.95	38.49	26.25
2016.92	142.65	127.95	117.05	85.74	55.50	36.92	25.22
2017.00	142.16	127.47	116.38	84.39	53.98	36.18	25.39
2017.08	141.12	126.68	115.76	83.59	53.36	36.09	25.64
2017.17	139.46	125.83	116.04	84.62	54.36	36.43	25.45
2017.25	137.61	125.59	117.36	86.62	55.91	36.87	25.08
2017.33	135.74	125.84	119.11	88.95	58.02	37.98	25.12
2017.42	134.10	125.96	120.61	90.98	59.85	39.01	25.30
2017.50	132.60	126.04	121.75	92.58	61.44	40.04	25.64
2017.58	130.85	125.72	122.53	93.80	62.73	41.03	26.14
2017.67	129.42	125.39	123.11	94.76	63.76	41.91	26.70
2017.75	128.07	124.97	123.55	95.62	64.77	42.84	27.39
2017.83	126.86	124.32	123.66	96.50	66.17	44.19	28.22
2017.92	125.54	123.86	124.44	98.53	68.49	45.62	28.49
2018.00	124.61	123.91	126.16	101.29	70.53	46.12	28.00
2018.08	124.63	125.35	128.95	103.95	71.85	46.41	27.99
2018.17	125.69	128.07	131.98	104.98	70.93	45.36	27.61

2018.25	127.18	130.75	133.80	103.93	68.10	43.06	26.71
2018.33	129.42	134.15	136.14	103.01	64.89	40.16	25.39
2018.42	130.94	136.81	138.71	103.16	62.66	37.75	24.18
2018.50	131.38	138.41	141.16	104.21	61.58	35.99	23.10
2018.58	131.77	139.81	143.60	105.99	61.68	35.04	22.17
2018.67	131.89	140.84	145.59	107.64	62.17	34.65	21.58
2018.75	132.31	142.09	147.52	109.22	62.91	34.74	21.33
2018.83	132.91	143.59	149.49	110.53	63.20	34.46	21.03
2018.92	133.77	145.14	150.82	110.57	62.42	33.97	21.27
2019.00	134.67	145.76	150.23	109.04	61.35	34.06	22.07
2019.08	135.44	145.77	149.09	107.83	61.06	34.35	22.33
2019.17	135.42	144.49	147.49	107.68	62.25	35.48	22.78
2019.25	134.49	142.74	146.98	109.77	65.45	37.58	23.39
2019.33	132.71	140.15	145.96	111.63	68.53	39.66	23.99
2019.42	131.11	137.53	144.00	112.32	71.07	41.73	24.68
2019.50	131.08	136.29	142.12	112.10	72.76	43.61	25.61
2019.58	131.35	135.49	140.13	110.93	73.26	44.82	26.49
2019.67	131.42	134.93	138.47	109.63	73.17	45.46	27.14
2019.75	131.20	134.07	136.91	108.32	72.62	45.46	27.42
2019.83	130.79	133.19	135.48	107.20	72.30	45.74	27.81
2019.92	130.39	132.43	134.50	106.91	72.93	46.46	27.88
2020.00	129.75	131.96	134.74	108.02	73.98	46.54	27.10
2020.08	129.60	131.98	135.24	108.47	73.68	45.74	26.44
2020.17	130.08	132.45	135.27	107.31	71.96	44.74	26.37
2020.25	130.89	132.99	134.83	105.40	69.78	43.85	26.70
2020.33	131.68	133.15	134.03	103.35	67.54	42.76	26.85
2020.42	133.26	134.42	134.58	102.42	65.82	41.66	26.82
2020.50	133.85	135.01	135.36	102.32	64.69	40.53	26.37
2020.58	133.20	134.57	135.85	102.68	64.19	39.68	25.89
2020.67	132.99	134.43	136.20	102.95	63.90	39.05	25.38
2020.75	132.81	134.41	136.51	103.16	63.70	38.61	24.98
2020.83	132.84	134.59	136.81	103.23	63.35	38.12	24.68
2020.92	132.94	134.77	136.87	102.81	62.63	37.70	24.73
2021.00	133.38	135.01	136.50	101.59	61.42	37.39	25.07
2021.08	133.08	134.29	135.51	100.94	61.55	38.01	25.55
2021.17	132.50	133.92	135.95	102.30	62.59	37.99	25.07
2021.25	132.16	133.89	137.03	104.40	63.86	37.57	24.01
2021.33	131.83	133.93	138.28	107.10	66.27	38.21	23.35
2021.42	131.15	133.71	139.05	109.30	68.82	39.66	23.46
2021.50	130.79	133.63	139.26	110.35	70.57	41.08	23.97

Table S6. Summary of linear trends fitted to time series of f-N₂O (ppb)

tropics	
32 hPa	-3.4 ± 0.8 %/dec
22 hPa	+0.8 ± 0.8 %/dec
15 hPa	+3.7 ± 1.4 %/dec
10 hPa	+5.5 ± 2.0 %/dec
6.8 hPa	+8.6 ± 2.6 %/dec
4.6 hPa	+12.0 ± 3.8 %/dec
3.2 hPa	+12.6 ± 4.7 %/dec
NH	
32 hPa	-14.9 ± 3.0 %/dec
22 hPa	-7.7 ± 3.2 %/dec
15 hPa	+0.6 ± 4.0 %/dec
10 hPa	+8.4 ± 4.9 %/dec
6.8 hPa	+16.1 ± 4.9 %/dec
4.6 hPa	+19.5 ± 4.6 %/dec
3.2 hPa	+18.3 ± 5.0 %/dec
SH	
32 hPa	-3.1 ± 2.5 %/dec
22 hPa	+4.0 ± 3.4 %/dec
15 hPa	+7.9 ± 4.3 %/dec
10 hPa	+7.2 ± 4.6 %/dec
6.8 hPa	+7.2 ± 4.7 %/dec
4.6 hPa	+11.1 ± 4.7 %/dec
3.2 hPa	+14.5 ± 3.7 %/dec

Table S7. N₂O budget table

	Troposphere	Burden	Lifetime	Loss	Atm. Incr.	Total	Anthrop.
	ppb	TgN	y	TgN/y	TgN/y	TgN/y	TgN/y
PI 1850s	272	1300	124.0*	10.5**	0***	10.5	0
2000s	319.6	1528	119.3	12.8	3.7	16.5	6.0
2010s	328.5	1570	117.0	13.4	4.7	18.1	7.6

Notes.

*Pre-industrial lifetime is 6% higher than current per P2015.

**The 1850s loss is assumed to be the Pre-Industrial (natural) emissions, i.e., 272 ppb (IPCC AR6) is the 'natural' PI value, and has not changed.

***The 1850s atmospheric increase in the IPCC scenarios (~0.5 ppb/y) is not observed but is derived from the assumed anthropogenic scenario.

Lifetime decreasing 2 %/dec from 2000s to 2010s.

Table S8. Calculated monthly loss of N₂O

Year	Loss N ₂ O	
	(kgN/s)	(TgN/mon)
2004.63	375.50	1.006
2004.71	409.50	1.061
2004.79	432.00	1.157
2004.88	424.50	1.100
2004.96	408.50	1.094
2005.04	411.40	1.102
2005.13	426.30	1.031
2005.21	439.70	1.178
2005.29	424.90	1.101
2005.38	399.00	1.069
2005.46	382.20	0.991
2005.54	383.70	1.028
2005.63	403.40	1.080
2005.71	418.70	1.085
2005.79	424.40	1.137
2005.88	417.90	1.083
2005.96	432.30	1.158
2006.04	471.00	1.262
2006.13	479.70	1.160
2006.21	447.20	1.198
2006.29	400.00	1.037
2006.38	355.70	0.953
2006.46	332.40	0.862
2006.54	333.10	0.892
2006.63	349.20	0.935
2006.71	376.70	0.976
2006.79	396.30	1.061
2006.88	404.70	1.049
2006.96	404.30	1.083
2007.04	424.70	1.138
2007.13	442.50	1.070
2007.21	454.10	1.216
2007.29	434.60	1.126
2007.38	405.40	1.086
2007.46	382.10	0.990
2007.54	380.40	1.019
2007.63	397.80	1.065
2007.71	411.50	1.067
2007.79	419.70	1.124
2007.88	411.70	1.067
2007.96	417.40	1.118

2008.04	452.90	1.213
2008.13	490.20	1.186
2008.21	483.30	1.294
2008.29	430.80	1.117
2008.38	375.30	1.005
2008.46	345.20	0.895
2008.54	337.90	0.905
2008.63	349.20	0.935
2008.71	373.10	0.967
2008.79	404.40	1.083
2008.88	414.90	1.075
2008.96	417.40	1.118
2009.04	435.40	1.166
2009.13	460.60	1.114
2009.21	448.70	1.202
2009.29	422.50	1.095
2009.38	397.40	1.064
2009.46	379.60	0.984
2009.54	372.40	0.997
2009.63	377.80	1.012
2009.71	394.40	1.022
2009.79	408.40	1.094
2009.88	420.80	1.091
2009.96	453.30	1.214
2010.04	478.10	1.281
2010.12	494.70	1.197
2010.21	466.30	1.249
2010.29	428.10	1.110
2010.37	394.00	1.055
2010.46	372.50	0.966
2010.54	374.40	1.003
2010.62	402.50	1.078
2010.71	411.40	1.066
2010.79	411.10	1.101
2010.87	403.60	1.046
2010.96	422.50	1.132
2011.04	471.30	1.262
2011.12	513.10	1.241
2011.21	510.00	1.366
2011.29	466.60	1.209
2011.37	427.70	1.146
2011.46	391.40	1.015
2011.54	376.40	1.008
2011.62	382.60	1.025

2011.71	393.80	1.021
2011.79	403.00	1.079
2011.87	415.40	1.077
2011.96	428.20	1.147
2012.04	462.50	1.239
2012.12	469.10	1.135
2012.21	456.20	1.222
2012.29	424.40	1.100
2012.37	383.90	1.028
2012.46	359.20	0.931
2012.54	360.00	0.964
2012.62	383.40	1.027
2012.71	397.30	1.030
2012.79	404.00	1.082
2012.87	391.90	1.016
2012.96	387.40	1.038
2013.04	437.20	1.171
2013.12	469.60	1.136
2013.21	460.60	1.234
2013.29	420.80	1.091
2013.37	371.20	0.994
2013.46	339.60	0.880
2013.54	340.90	0.913
2013.62	371.20	0.994
2013.71	410.30	1.063
2013.79	433.70	1.162
2013.87	430.10	1.115
2013.96	410.90	1.101
2014.04	417.50	1.118
2014.12	442.40	1.070
2014.21	460.20	1.233
2014.29	450.40	1.167
2014.37	417.00	1.117
2014.46	388.50	1.007
2014.54	380.10	1.018
2014.62	400.10	1.072
2014.71	417.30	1.082
2014.79	431.40	1.155
2014.87	432.90	1.122
2014.96	445.00	1.192
2015.04	471.90	1.264
2015.12	479.20	1.159
2015.21	458.00	1.227
2015.29	424.20	1.100

2015.37	385.40	1.032
2015.46	367.30	0.952
2015.54	370.70	0.993
2015.62	383.80	1.028
2015.71	399.90	1.037
2015.79	411.00	1.101
2015.87	407.60	1.056
2015.96	406.50	1.089
2016.04	425.10	1.139
2016.12	459.10	1.111
2016.21	480.70	1.288
2016.29	464.50	1.204
2016.37	423.90	1.135
2016.46	397.30	1.030
2016.54	392.20	1.050
2016.62	407.00	1.090
2016.71	427.80	1.109
2016.79	426.90	1.143
2016.87	421.00	1.091
2016.96	415.60	1.113
2017.04	433.40	1.161
2017.12	469.10	1.135
2017.21	486.30	1.303
2017.29	468.10	1.213
2017.37	428.10	1.147
2017.46	396.20	1.027
2017.54	391.60	1.049
2017.62	415.90	1.114
2017.71	440.50	1.142
2017.79	448.40	1.201
2017.87	447.40	1.160
2017.96	442.80	1.186
2018.04	456.40	1.222
2018.12	475.70	1.151
2018.21	464.60	1.244
2018.29	428.00	1.109
2018.37	397.90	1.066
2018.46	380.20	0.985
2018.54	377.80	1.012
2018.62	393.00	1.053
2018.71	410.20	1.063
2018.79	410.60	1.100
2018.87	405.50	1.051
2018.96	429.50	1.150

2019.04	491.80	1.317
2019.12	519.60	1.257
2019.21	515.20	1.380
2019.29	486.40	1.261
2019.37	440.50	1.180
2019.46	398.40	1.033
2019.54	384.70	1.030
2019.62	396.30	1.061
2019.71	429.90	1.114
2019.79	450.20	1.206
2019.87	451.50	1.170
2019.96	461.60	1.236
2020.04	489.10	1.310
2020.12	502.30	1.215
2020.21	495.30	1.327
2020.29	475.90	1.234
2020.37	443.00	1.187
2020.46	416.40	1.079
2020.54	405.00	1.085
2020.62	416.90	1.117
2020.71	431.30	1.118
2020.79	426.90	1.143
2020.87	419.00	1.086
2020.96	426.30	1.142
2021.04	463.10	1.240
2021.12	483.60	1.170
2021.21	471.20	1.262
2021.29	448.00	1.161
2021.37	419.50	1.124
2021.46	392.00	1.016
2021.54	381.90	1.023
2021.62	392.90	1.052
2021.71	406.90	1.055
2021.79	412.50	1.105
2021.87	424.10	1.099
2021.96	451.50	1.209

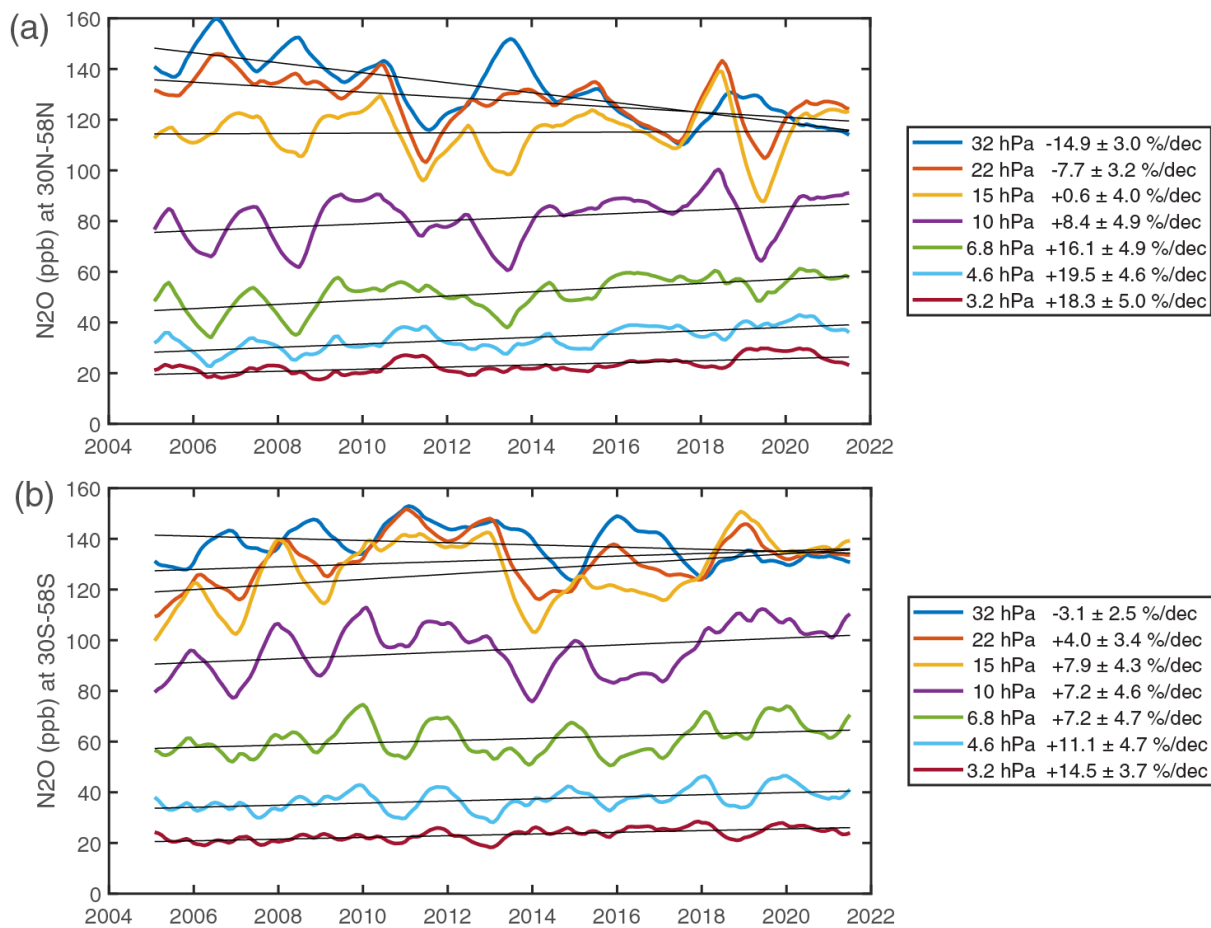


Figure S1. Time series of stratospheric f-N₂O (ppb, dry air mole fraction) at **(a)** northern mid-latitudes (30 °N – 58 °N) and **(b)** southern mid-latitudes (30 °S – 58 °S). See main text Fig. 1

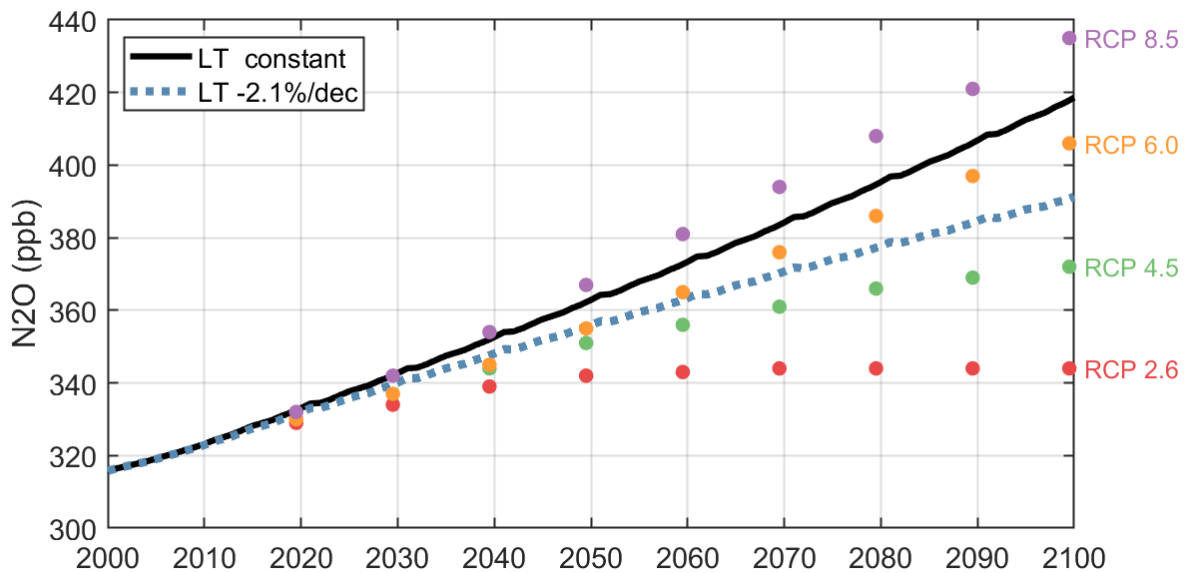


Figure S2. Projected N₂O tropospheric annual mean abundance (black line) assuming the observed 2.9 %/decade growth rate. The last observed decade 2012-2021 is used to project future decades, and hence there is a recurring interannual variability (IAV). Projected N₂O with the lifetime decreasing by 2.1 %/decade from 120 y in 2000 to 97 y in 2100 (blue dotted line) uses the emissions inferred from fixed growth scenario. The RCP scenario projections, shown for perspective, are taken from the Annex II tables of the IPCC WGI AR4 (2013).

IPCC, 2013: Annex II: Climate System Scenario Tables [Prather, M., G. Flato, P. Friedlingstein, C. Jones, J.-F. Lamarque, H. Liao and P. Rasch (eds.)]. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1395-1445, published 31 January 2014, ISBN 978-1-107-05799-1, 2014.