

1 Supplementary Materials

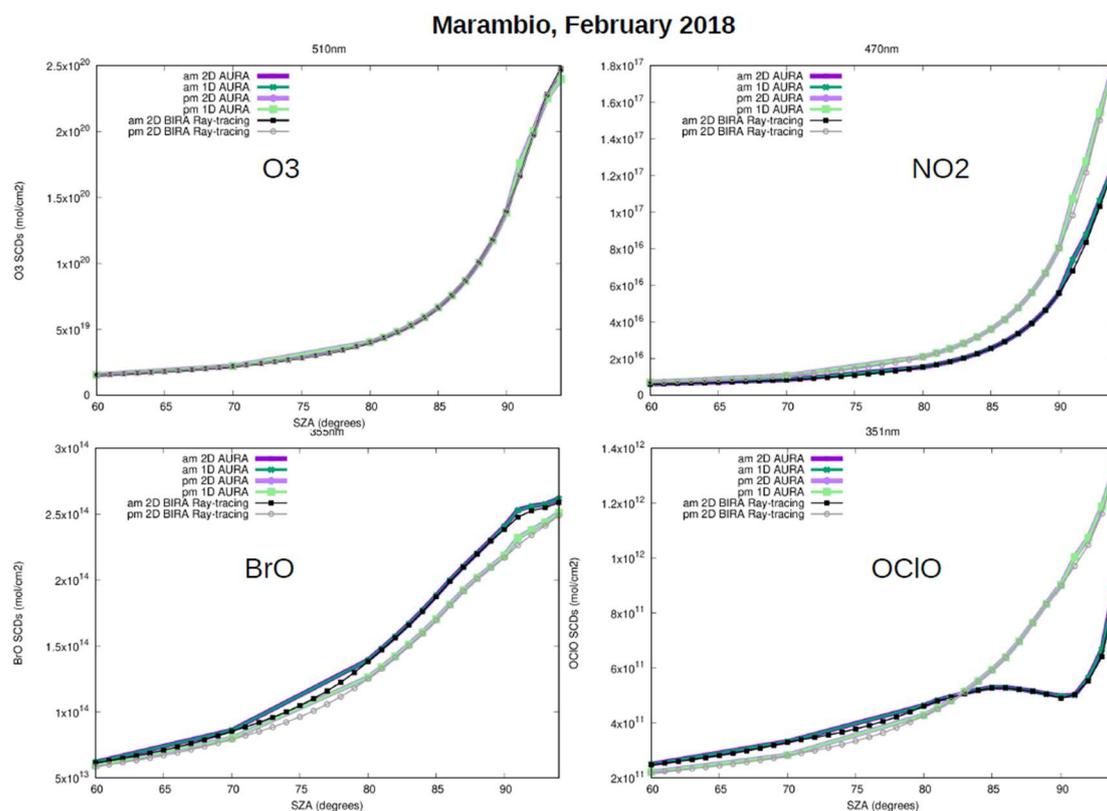
2 UV/Vis Stratospheric Air Mass Factors at two Antarctic stations 3 considering photochemistry

4 L. Gómez-Martín, C. Prados-Roman, M. Chipperfield, M. van Roozendael, O. Puentedura,
5 M. Navarro-Comas, H. Ochoa, M. Yela

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7 This supplementary material includes information on the comparison of the different
8 approximations and RT models considered in this work, and provides the values of the obtained
9 monthly averaged AMFs and photo-chemical model VCDs.

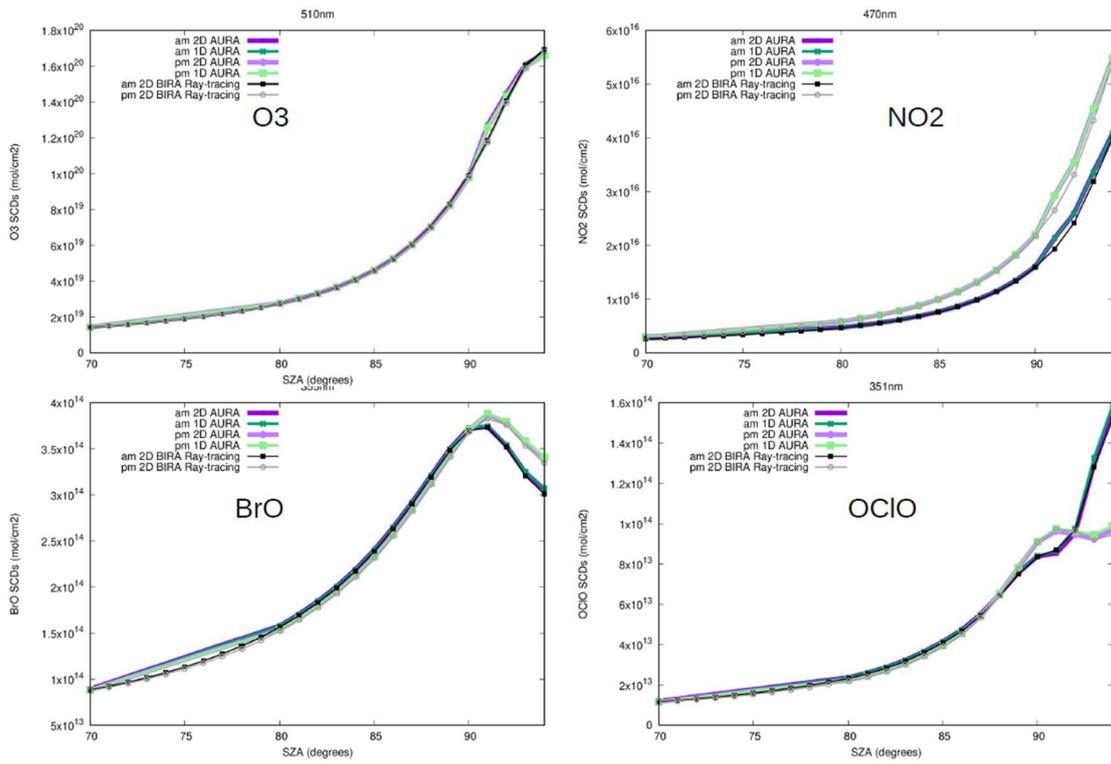
10 S1. Comparison AURA 1D – 2D calculations:



11

12 **Figure S1** Sunrise (am, dark violet and green) and sunset (pm, light violet and green) monthly SCD of O₃
13 (top left), NO₂ (top right), BrO (bottom left) and OCIO (bottom right) for Marambio, February 2018. 2D
14 SCDs have been obtained with AURA by using the chemical model (violet), and 1D SCDs have been
15 obtained with AURA by using the optical path averaged concentrations (i.e. a single profile for the whole
16 atmosphere). 2D BIRA ray-tracing model results are also shown for comparison (am: black, pm: grey).

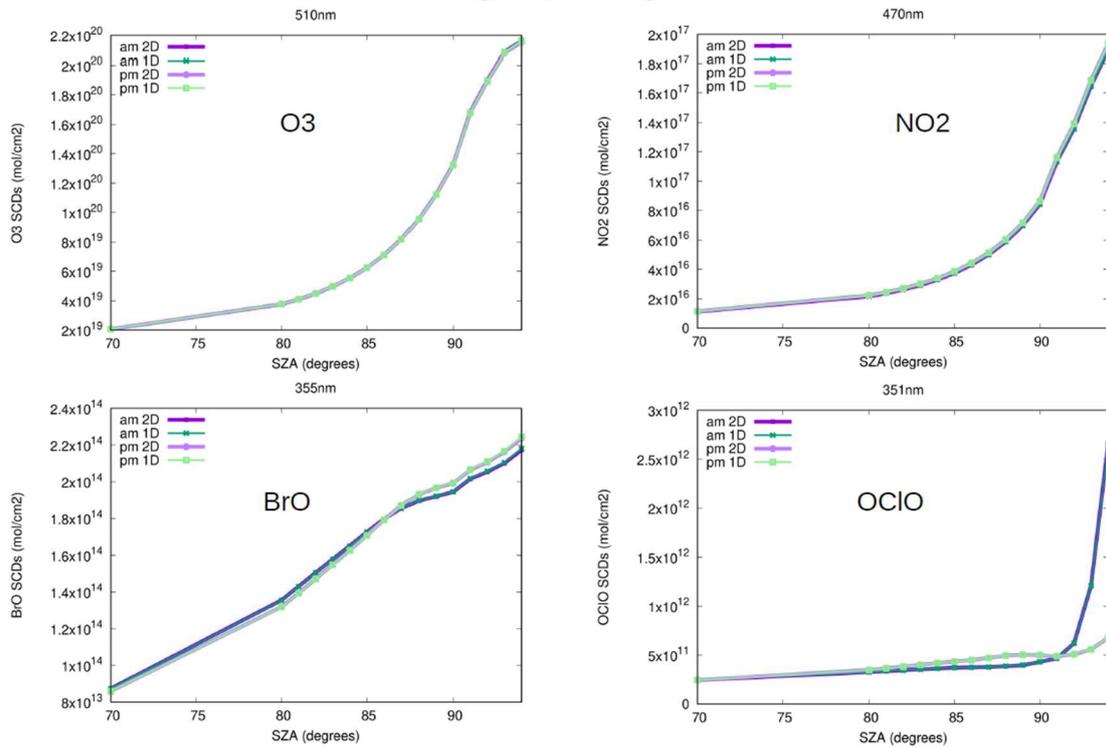
Marambio, September 2018



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18 Figure S2 Same as S1 but for Marambio, September 2018.

Belgrano, February 2018



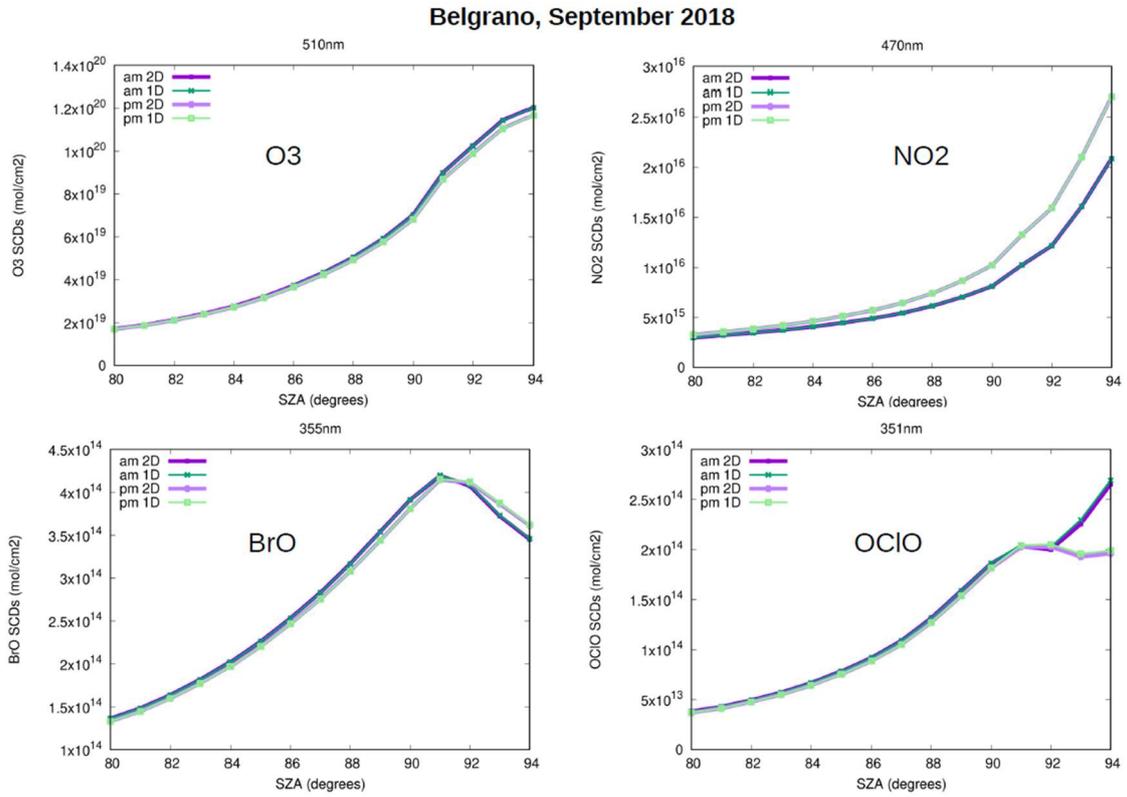
19

20 Figure S3 Same as S1 but for Belgrano, February 2018.

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25 **Figure S4** Same as S1 but for Belgrano, September 2018.

26

27 **S2. Marambio monthly averaged AMF values:**

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	5.31	5.33	5.33	5.22	---	---	---	5.29	5.25	5.25	5.35	5.30
	5.47	5.48	5.50	5.40	---	---	---	5.48	5.47	5.47	5.48	5.46
81	5.80	5.83	5.85	5.82	---	---	---	5.53	5.61	5.63	5.83	5.78
	5.95	5.99	6.02	6.01	---	---	---	5.73	5.81	5.85	5.98	5.92
82	6.34	6.39	6.40	6.36	---	---	---	5.89	6.04	6.06	6.39	6.30
	6.48	6.55	6.58	6.57	---	---	---	6.08	6.26	6.28	6.54	6.47
83	6.94	7.01	7.02	6.95	6.86	---	---	6.54	6.52	6.53	7.00	6.89
	7.09	7.18	7.21	7.15	7.05	---	---	6.74	6.75	6.74	7.16	7.06
84	7.68	7.83	7.81	7.71	7.49	---	---	7.08	7.07	7.08	7.78	7.63
	7.86	7.99	8.02	7.92	7.69	---	---	7.31	7.31	7.32	7.94	7.79
85	8.69	8.88	8.87	8.66	8.18	---	---	7.77	7.73	7.72	8.78	8.58
	8.86	9.05	9.08	8.89	8.38	---	---	7.98	8.00	7.99	8.95	8.75
86	10.09	10.28	10.26	9.86	5.82	---	8.27	8.49	8.48	8.45	10.10	9.89
	10.25	10.49	10.46	10.13	5.98	---	8.52	8.74	8.72	8.69	10.30	10.05
87	11.60	11.86	11.74	10.99	9.00	---	8.89	9.13	9.08	9.02	11.50	11.28
	11.78	12.06	12.01	11.28	9.24	---	9.13	9.35	9.34	9.23	11.71	11.44
88	13.67	14.00	13.89	12.39	10.23	6.67	9.83	9.86	9.71	9.52	13.31	13.11
	13.87	14.27	14.19	12.72	10.47	6.80	10.04	10.10	9.98	9.84	13.53	13.33
89	16.64	16.49	15.69	12.89	10.66	10.07	10.83	10.39	10.17	9.85	15.45	15.59
	16.87	16.81	16.00	13.28	10.96	10.29	11.01	10.67	10.50	10.14	15.77	15.82
90	19.77	14.36	11.25	8.04	9.89	11.00	11.03	10.34	9.93	9.22	15.44	18.68
	20.09	14.96	11.90	8.69	10.24	11.32	11.31	10.64	10.27	9.52	15.85	18.91
91	17.36	7.57	5.33	3.86	6.93	10.03	9.97	8.55	7.65	6.86	9.86	20.48
	17.92	8.41	6.11	4.48	7.31	10.33	10.25	8.85	7.97	7.17	10.50	20.85
92	12.05	4.64	3.40	2.60	3.70	6.22	6.26	4.95	4.12	3.43	5.93	19.48
	12.83	5.53	4.11	3.12	4.06	6.51	6.57	5.26	4.40	3.70	6.69	20.04
93	8.47	3.56	2.77	2.20	2.43	3.29	3.41	2.95	2.58	2.37	4.31	---
	9.30	4.42	3.40	2.61	2.74	3.51	3.64	3.18	2.83	2.59	5.10	---
94	6.15	3.25	2.73	2.22	2.28	2.71	2.77	2.57	2.37	2.29	3.48	---
	6.96	3.99	3.29	2.60	2.55	2.90	2.97	2.79	2.60	2.51	4.11	---

28 **Table S1.** Monthly averaged OCIO AMFs for Marambio for sunrise (am). Green background is for values
 29 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

30

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	5.27	5.27	5.26	5.18	---	---	---	5.31	5.26	5.25	5.31	5.28
	5.43	5.43	5.45	5.37	---	---	---	5.49	5.46	5.45	5.43	5.42
81	5.71	5.72	5.68	5.66	---	---	---	5.54	5.62	5.63	5.76	5.73
	5.88	5.86	5.85	5.85	---	---	---	5.74	5.83	5.85	5.88	5.86
82	6.20	6.20	6.13	6.10	---	---	---	5.89	6.05	6.08	6.27	6.22
	6.36	6.36	6.31	6.30	---	---	---	6.09	6.27	6.27	6.39	6.36
83	6.77	6.75	6.65	6.59	6.59	---	---	6.56	6.54	6.54	6.86	6.79
	6.92	6.90	6.83	6.78	6.79	---	---	6.76	6.75	6.74	6.99	6.94
84	7.49	7.45	7.30	7.22	7.18	---	---	7.13	7.13	7.13	7.62	7.52
	7.65	7.62	7.49	7.41	7.38	---	---	7.33	7.32	7.33	7.74	7.69
85	8.33	8.31	8.04	7.89	7.77	---	---	7.79	7.78	7.78	8.53	8.41
	8.52	8.47	8.23	8.12	7.96	---	---	8.03	8.00	7.99	8.66	8.56
86	9.35	9.26	8.87	8.66	6.12	---	8.31	8.55	8.49	8.47	9.61	9.45

	9.53	9.45	9.07	8.89	6.29	---	8.51	8.77	8.74	8.72	9.74	9.60
87	10.54	10.31	9.66	9.28	8.77	---	8.90	9.22	9.13	9.09	10.81	10.67
	10.73	10.50	9.86	9.53	8.98	---	9.11	9.42	9.35	9.29	10.96	10.82
88	12.38	11.78	10.66	10.02	9.91	6.78	9.82	9.90	9.78	9.67	12.59	12.51
	12.53	11.99	10.91	10.32	10.13	6.96	10.07	10.16	10.11	9.94	12.72	12.69
89	14.74	13.54	11.61	10.56	10.40	9.99	10.73	10.38	10.25	9.98	14.92	14.87
	14.95	13.75	11.85	10.80	10.65	10.24	11.01	10.70	10.50	10.31	15.08	15.07
90	17.84	15.25	11.76	10.09	9.88	10.62	10.67	10.18	9.93	9.42	17.54	18.00
	18.03	15.49	12.08	10.38	10.15	10.94	10.99	10.38	10.18	9.72	17.78	18.20
91	21.38	16.27	11.00	8.67	8.58	9.87	9.67	8.91	8.49	7.82	19.69	21.39
	21.57	16.51	11.28	9.00	8.87	10.12	9.95	9.22	8.78	8.06	19.81	21.59
92	27.87	16.90	9.05	6.21	5.77	6.94	6.86	6.19	5.64	4.99	21.57	27.71
	28.03	17.09	9.37	6.51	6.07	7.19	7.11	6.47	5.95	5.26	21.72	27.91
93	---	16.17	7.59	4.67	4.07	4.82	4.80	4.33	3.89	3.56	18.91	---
	---	16.34	7.87	4.94	4.34	5.09	5.05	4.55	4.14	3.81	19.04	---
94	---	14.03	6.65	3.93	3.27	3.69	3.71	3.44	3.18	3.04	14.64	---
	---	14.19	6.91	4.19	3.50	3.88	3.92	3.67	3.39	3.26	14.71	---

31 **Table S2** Monthly averaged OCIO AMFs for Marambio for sunset (pm). Green background is for values
32 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

33

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	5.08	5.12	5.13	5.15	---	---	---	5.21	5.20	5.21	5.14	5.11
	5.32	5.35	5.36	5.37	---	---	---	5.41	5.40	5.40	5.38	5.34
81	5.44	5.50	5.52	5.53	---	---	---	5.57	5.61	5.61	5.55	5.49
	5.69	5.73	5.75	5.76	---	---	---	5.77	5.80	5.81	5.77	5.74
82	5.84	5.95	5.95	5.98	---	---	---	6.02	6.06	6.08	6.01	5.93
	6.10	6.19	6.19	6.20	---	---	---	6.23	6.27	6.28	6.23	6.18
83	6.34	6.48	6.47	6.49	6.47	---	---	6.55	6.60	6.63	6.54	6.45
	6.58	6.71	6.72	6.73	6.70	---	---	6.77	6.81	6.83	6.76	6.71
84	6.91	7.08	7.11	7.11	7.08	---	---	7.18	7.22	7.28	7.17	7.05
	7.14	7.33	7.33	7.34	7.31	---	---	7.40	7.44	7.49	7.40	7.29
85	7.59	7.84	7.86	7.84	7.77	---	---	7.91	7.97	8.06	7.94	7.79
	7.82	8.07	8.08	8.09	8.00	---	---	8.12	8.18	8.29	8.16	8.02
86	8.40	8.79	8.84	8.80	8.55	---	8.66	8.78	8.88	9.06	8.93	8.69
	8.64	9.02	9.06	9.04	8.78	---	8.88	8.98	9.07	9.25	9.16	8.93
87	9.41	10.06	10.07	10.06	9.78	---	9.78	9.83	9.96	10.28	10.23	9.96
	9.65	10.28	10.33	10.31	10.02	---	10.00	10.07	10.19	10.48	10.45	10.19
88	10.70	11.73	11.75	11.69	11.21	11.15	10.91	11.07	11.23	11.71	11.92	11.54
	10.93	11.94	11.99	11.91	11.47	11.38	11.16	11.32	11.48	11.95	12.09	11.78
89	12.38	14.03	14.10	14.06	13.16	12.87	12.32	12.55	12.70	13.44	14.14	13.69
	12.61	14.24	14.35	14.27	13.37	13.11	12.51	12.75	12.95	13.68	14.33	13.96
90	14.62	17.62	18.00	17.90	16.14	15.09	14.10	14.61	14.64	15.74	17.50	16.96
	14.85	17.83	18.23	18.20	16.37	15.39	14.37	14.76	14.94	15.89	17.77	17.18
91	17.78	23.41	24.17	24.19	20.71	18.69	17.26	17.79	17.78	19.05	22.88	22.13
	17.92	23.64	24.44	24.43	20.99	18.96	17.50	18.06	18.02	19.31	23.05	22.36
92	20.80	35.71	38.39	39.41	31.62	26.97	24.49	26.05	25.75	28.04	33.84	31.80
	20.97	35.91	38.73	39.90	31.93	27.22	24.83	26.42	26.03	28.43	34.07	31.97
93	23.38	60.43	69.02	75.34	57.78	52.30	49.67	54.55	51.35	54.28	56.02	---
	23.45	60.81	69.21	76.03	58.59	52.80	50.44	54.80	51.92	54.88	56.25	---
94	25.17	98.68	120.22	136.32	94.33	101.53	110.22	118.48	105.87	101.29	85.70	---
	25.29	99.06	120.85	137.28	95.31	102.59	111.85	120.78	107.23	102.09	86.23	---

34 **Table S3** Monthly averaged BrO AMFs for Marambio for sunrise (am). Green background is for values
 35 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

36

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	5.07	5.11	5.13	5.15	---	---	---	5.21	5.21	5.21	5.13	5.10
	5.32	5.34	5.36	5.37	---	---	---	5.41	5.41	5.40	5.37	5.33
81	5.42	5.48	5.50	5.53	---	---	---	5.58	5.60	5.60	5.53	5.48
	5.67	5.72	5.75	5.76	---	---	---	5.79	5.80	5.79	5.76	5.72
82	5.83	5.92	5.93	5.96	---	---	---	6.03	6.06	6.05	5.97	5.91
	6.08	6.16	6.17	6.20	---	---	---	6.24	6.26	6.26	6.20	6.15
83	6.31	6.43	6.44	6.47	6.49	---	---	6.56	6.60	6.60	6.51	6.42
	6.55	6.66	6.68	6.71	6.71	---	---	6.78	6.80	6.81	6.73	6.67
84	6.86	7.02	7.03	7.08	7.09	---	---	7.20	7.23	7.25	7.13	7.01
	7.11	7.26	7.29	7.31	7.33	---	---	7.41	7.43	7.44	7.36	7.26
85	7.53	7.72	7.70	7.76	7.73	---	---	7.92	7.96	7.98	7.88	7.72
	7.77	7.96	7.96	8.00	7.98	---	---	8.13	8.17	8.21	8.09	7.96
86	8.29	8.54	8.54	8.56	8.46	---	8.66	8.77	8.82	8.92	8.76	8.58
	8.53	8.81	8.77	8.81	8.71	---	8.89	8.99	9.05	9.11	9.00	8.80
87	9.25	9.67	9.54	9.56	9.56	---	9.78	9.82	9.90	10.08	10.00	9.76
	9.50	9.92	9.81	9.82	9.82	---	10.04	10.07	10.12	10.30	10.24	10.01
88	10.46	11.07	10.87	10.78	10.68	11.01	10.94	11.03	11.16	11.48	11.56	11.30
	10.68	11.34	11.13	11.06	10.98	11.27	11.19	11.31	11.36	11.70	11.82	11.54
89	12.06	12.90	12.42	12.19	12.01	12.52	12.24	12.40	12.55	13.19	13.67	13.30
	12.22	13.16	12.70	12.52	12.27	12.77	12.54	12.64	12.80	13.45	13.91	13.53
90	14.21	15.57	14.56	13.90	13.37	13.97	13.78	13.86	13.98	15.28	16.71	16.39
	14.38	15.77	14.87	14.21	13.70	14.29	14.00	14.14	14.32	15.48	17.00	16.64
91	17.26	19.36	17.41	16.01	14.98	15.62	15.43	15.47	15.33	17.55	21.29	21.09
	17.43	19.61	17.70	16.30	15.30	15.92	15.72	15.70	15.58	17.81	21.46	21.32
92	20.58	27.14	23.13	19.85	17.38	17.87	17.73	17.41	16.90	21.28	30.33	30.73
	20.70	27.43	23.45	20.19	17.74	18.18	17.98	17.67	17.22	21.52	30.48	30.91
93	---	40.09	32.41	25.88	20.64	20.88	20.94	19.92	19.06	26.63	44.48	---
	---	40.48	32.91	26.23	21.00	21.27	21.20	20.24	19.35	26.90	44.49	---
94	---	58.59	46.99	34.77	25.04	25.23	25.48	23.43	22.10	33.72	63.40	---
	---	58.93	47.41	35.29	25.50	25.58	25.88	23.74	22.46	34.20	63.80	---

37 **Table S4** Monthly averaged BrO AMFs for Marambio for sunset (pm). Green background is for values
 38 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

39

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	5.13	5.12	5.12	5.27	---	---	0.00	4.94	5.03	5.05	5.12	5.12
	5.19	5.19	5.19	5.37	---	---	0.00	5.12	5.18	5.18	5.19	5.19
81	5.55	5.54	5.54	5.58	---	---	0.00	5.40	5.46	5.47	5.54	5.55
	5.61	5.61	5.61	5.67	---	---	0.00	5.59	5.60	5.60	5.62	5.61
82	6.06	6.04	6.03	6.04	---	---	0.00	6.00	5.95	5.95	6.05	6.06
	6.11	6.11	6.11	6.13	---	---	0.00	6.18	6.09	6.08	6.11	6.11
83	6.64	6.62	6.61	6.61	6.90	---	0.00	6.54	6.51	6.51	6.63	6.64
	6.69	6.68	6.67	6.69	7.02	---	0.00	6.71	6.65	6.63	6.69	6.69
84	7.35	7.32	7.30	7.29	7.45	---	0.00	7.20	7.20	7.19	7.33	7.35
	7.39	7.37	7.36	7.38	7.57	---	0.00	7.37	7.33	7.31	7.39	7.39

85	8.21	8.16	8.14	8.12	8.37	---	0.00	8.01	8.03	8.02	8.19	8.21
	8.23	8.21	8.19	8.20	8.50	---	0.00	8.18	8.15	8.13	8.23	8.24
86	9.21	9.17	9.12	9.10	10.07	---	9.13	8.98	9.02	9.00	9.20	9.23
	9.26	9.20	9.17	9.18	10.19	---	9.25	9.15	9.13	9.10	9.23	9.26
87	10.34	10.27	10.20	10.18	11.07	---	11.21	10.05	10.09	10.06	10.31	10.35
	10.38	10.30	10.25	10.23	11.18	---	11.34	10.19	10.20	10.15	10.35	10.39
88	11.73	11.61	11.52	11.46	12.17	12.47	12.36	11.33	11.38	11.33	11.65	11.77
	11.79	11.66	11.55	11.51	12.28	12.63	12.48	11.44	11.48	11.43	11.71	11.80
89	13.47	13.29	13.11	13.07	13.52	14.29	13.50	12.83	12.97	12.93	13.34	13.49
	13.51	13.32	13.16	13.08	13.63	14.41	13.59	12.95	13.07	13.01	13.38	13.53
90	15.56	15.30	15.07	14.93	15.19	16.17	14.85	14.61	14.82	14.74	15.35	15.64
	15.62	15.31	15.11	15.02	15.27	16.28	15.01	14.80	14.86	14.83	15.39	15.66
91	18.03	17.58	17.21	16.94	16.82	17.49	16.10	16.30	16.70	16.71	17.64	18.10
	18.06	17.62	17.27	17.01	16.86	17.62	16.17	16.44	16.75	16.80	17.72	18.14
92	20.39	19.78	19.15	18.59	18.02	18.78	17.38	17.67	18.10	18.13	19.74	20.52
	20.45	19.78	19.20	18.63	18.10	18.83	17.43	17.74	18.20	18.22	19.79	20.52
93	22.46	21.55	20.59	19.33	17.99	18.49	17.53	17.53	18.71	19.05	21.58	---
	22.38	21.54	20.54	19.35	18.01	18.56	17.56	17.48	18.68	19.15	21.55	---
94	24.94	23.26	22.11	20.34	18.19	18.37	17.56	17.77	19.41	19.85	22.98	---
	24.96	23.22	22.12	20.28	18.21	18.35	17.60	17.75	19.48	19.93	23.07	---

40 **Table S5** Monthly averaged NO₂ AMFs for Marambio for sunrise (am). Green background is for values
41 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

42

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	5.14	5.13	5.10	5.22	---	---	---	4.99	5.04	5.08	5.13	5.14
	5.19	5.17	5.16	5.30	---	---	---	5.14	5.15	5.17	5.19	5.19
81	5.58	5.55	5.53	5.52	---	---	---	5.38	5.47	5.50	5.56	5.56
	5.63	5.60	5.58	5.59	---	---	---	5.53	5.57	5.59	5.62	5.62
82	6.09	6.05	6.02	5.97	---	---	---	5.96	5.96	6.00	6.07	6.08
	6.13	6.10	6.08	6.04	---	---	---	6.11	6.06	6.08	6.12	6.12
83	6.68	6.64	6.61	6.54	6.68	---	---	6.45	6.53	6.57	6.66	6.66
	6.72	6.68	6.65	6.61	6.78	---	---	6.58	6.63	6.66	6.71	6.71
84	7.40	7.34	7.31	7.23	7.28	---	---	7.07	7.23	7.27	7.38	7.38
	7.44	7.38	7.35	7.29	7.38	---	---	7.19	7.31	7.34	7.42	7.42
85	8.26	8.20	8.15	8.07	8.17	---	---	7.87	8.07	8.12	8.25	8.25
	8.30	8.23	8.19	8.12	8.27	---	---	7.99	8.15	8.18	8.28	8.28
86	9.31	9.21	9.16	9.06	9.71	---	8.86	8.83	9.07	9.12	9.26	9.28
	9.34	9.25	9.19	9.09	9.80	---	8.95	8.94	9.13	9.19	9.30	9.31
87	10.48	10.34	10.27	10.13	10.45	---	10.82	9.88	10.17	10.23	10.42	10.44
	10.51	10.37	10.28	10.17	10.54	---	10.92	9.97	10.22	10.27	10.45	10.47
88	11.93	11.73	11.61	11.47	11.46	12.02	11.71	11.17	11.52	11.58	11.85	11.87
	11.97	11.76	11.64	11.49	11.53	12.16	11.80	11.25	11.57	11.64	11.88	11.90
89	13.75	13.44	13.31	13.09	12.82	13.03	12.66	12.73	13.18	13.27	13.60	13.67
	13.78	13.50	13.34	13.18	12.87	13.18	12.74	12.77	13.23	13.30	13.62	13.68
90	15.98	15.55	15.39	15.13	14.60	14.37	13.88	14.55	15.20	15.18	15.70	15.89
	16.04	15.61	15.39	15.16	14.65	14.50	14.06	14.63	15.17	15.24	15.76	15.90
91	18.59	18.01	17.68	17.30	16.47	15.78	15.21	16.40	17.19	17.36	18.16	18.40
	18.63	18.05	17.73	17.33	16.52	15.88	15.30	16.47	17.24	17.38	18.19	18.42
92	21.03	20.34	19.78	19.10	17.97	17.10	16.51	17.88	18.85	19.05	20.47	20.93
	21.07	20.37	19.81	19.11	18.04	17.12	16.55	17.88	18.91	19.13	20.47	20.95
93	---	22.34	21.48	20.27	18.53	17.58	17.22	18.59	19.96	20.45	22.53	---

	0.00	22.33	21.42	20.19	18.58	17.62	17.11	18.56	19.99	20.44	22.54	0.00
94	0.00	24.18	23.13	21.42	19.36	18.43	18.24	19.74	21.27	21.61	24.20	0.00
	0.00	24.13	23.10	21.38	19.40	18.48	18.20	19.77	21.17	21.65	24.20	0.00

43 **Table S6** Monthly averaged NO₂ AMFs for Marambio for sunset (pm). Green background is for values
 44 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

45

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	5.10	5.11	5.09	5.13	---	---	---	5.06	5.01	5.01	5.09	5.10
	5.24	5.23	5.24	5.29	---	---	---	5.25	5.21	5.19	5.23	5.23
81	5.54	5.54	5.54	5.54	---	---	---	5.44	5.46	5.44	5.52	5.54
	5.68	5.68	5.67	5.69	---	---	---	5.62	5.65	5.62	5.65	5.66
82	6.06	6.07	6.06	6.04	---	---	---	5.98	5.98	5.94	6.05	6.07
	6.19	6.18	6.18	6.19	---	---	---	6.15	6.16	6.12	6.17	6.18
83	6.69	6.69	6.68	6.68	6.61	---	---	6.64	6.60	6.54	6.68	6.69
	6.80	6.80	6.81	6.81	6.76	---	---	6.80	6.77	6.71	6.78	6.80
84	7.44	7.44	7.43	7.42	7.38	---	---	7.41	7.35	7.28	7.42	7.44
	7.54	7.55	7.55	7.54	7.51	---	---	7.57	7.50	7.43	7.53	7.53
85	8.36	8.36	8.34	8.35	8.26	---	---	8.35	8.25	8.16	8.33	8.35
	8.45	8.44	8.45	8.46	8.38	---	---	8.50	8.39	8.29	8.43	8.44
86	9.49	9.49	9.49	9.50	9.49	---	9.42	9.53	9.38	9.24	9.46	9.47
	9.55	9.55	9.56	9.57	9.59	---	9.53	9.65	9.50	9.36	9.52	9.54
87	10.86	10.87	10.87	10.91	11.05	---	11.07	10.99	10.79	10.57	10.83	10.85
	10.93	10.91	10.92	10.99	11.12	---	11.13	11.09	10.87	10.66	10.88	10.89
88	12.56	12.57	12.60	12.66	12.85	12.60	12.89	12.80	12.53	12.20	12.50	12.52
	12.62	12.63	12.65	12.74	12.91	12.70	12.96	12.93	12.61	12.28	12.56	12.56
89	14.70	14.67	14.72	14.81	15.05	15.04	15.20	15.17	14.67	14.20	14.56	14.58
	14.70	14.65	14.75	14.92	15.14	15.12	15.27	15.22	14.80	14.30	14.60	14.64
90	17.19	17.22	17.26	17.50	17.79	18.02	18.10	18.02	17.40	16.62	17.04	17.03
	17.23	17.29	17.35	17.59	17.85	18.03	18.14	18.09	17.52	16.69	17.16	17.14
91	20.26	20.33	20.50	20.83	21.27	21.55	21.66	21.54	20.68	19.52	20.08	20.11
	20.34	20.36	20.55	20.89	21.32	21.67	21.73	21.61	20.72	19.59	20.10	20.13
92	23.74	23.88	24.21	24.72	25.26	25.71	25.66	25.47	24.36	22.87	23.59	23.55
	23.87	23.96	24.22	24.73	25.33	25.71	25.76	25.59	24.48	22.93	23.61	23.62
93	26.96	27.28	27.86	28.34	29.19	29.66	29.20	28.94	27.65	26.32	27.09	---
	27.15	27.33	27.86	28.43	29.17	29.50	29.52	28.86	27.64	26.30	27.17	---
94	29.53	29.59	30.20	30.79	31.40	31.53	30.87	30.09	29.30	29.00	29.68	---
	29.59	29.67	30.17	30.80	31.41	31.56	31.04	30.21	29.42	28.96	29.84	---

46 **Table S7** Monthly averaged O₃ AMFs for Marambio for sunrise (am). Green background is for values
 47 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

48

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	5.10	5.10	5.09	5.13	---	---	---	5.06	5.01	5.01	5.09	5.10
	5.23	5.24	5.23	5.28	---	---	---	5.25	5.21	5.19	5.22	5.23
81	5.54	5.54	5.53	5.53	---	---	---	5.45	5.46	5.44	5.53	5.55
	5.67	5.68	5.67	5.69	---	---	---	5.62	5.65	5.61	5.66	5.66
82	6.06	6.06	6.05	6.04	---	---	---	5.98	5.97	5.94	6.05	6.06
	6.19	6.19	6.18	6.19	---	---	---	6.15	6.16	6.12	6.18	6.18
83	6.69	6.69	6.68	6.67	6.59	---	---	6.64	6.59	6.55	6.67	6.69

	6.80	6.80	6.80	6.81	6.75	---	---	6.82	6.77	6.72	6.79	6.80
84	7.45	7.45	7.44	7.43	7.37	---	---	7.42	7.34	7.28	7.42	7.44
	7.55	7.54	7.54	7.56	7.52	---	---	7.58	7.49	7.43	7.53	7.55
85	8.37	8.37	8.35	8.36	8.26	---	---	8.36	8.26	8.16	8.34	8.35
	8.46	8.45	8.45	8.45	8.37	---	---	8.50	8.39	8.29	8.42	8.44
86	9.49	9.50	9.47	9.51	9.49	---	9.45	9.52	9.37	9.25	9.46	9.49
	9.58	9.55	9.57	9.58	9.59	---	9.54	9.64	9.49	9.36	9.53	9.54
87	10.89	10.87	10.86	10.92	11.02	---	11.06	10.98	10.77	10.57	10.83	10.86
	10.93	10.93	10.94	10.99	11.11	---	11.14	11.09	10.88	10.65	10.89	10.91
88	12.59	12.59	12.60	12.68	12.84	12.61	12.89	12.84	12.52	12.19	12.51	12.55
	12.65	12.62	12.64	12.74	12.92	12.70	12.97	12.91	12.62	12.28	12.56	12.59
89	14.68	14.64	14.72	14.85	15.05	15.08	15.21	15.11	14.67	14.17	14.57	14.59
	14.73	14.74	14.77	14.92	15.13	15.15	15.30	15.23	14.72	14.25	14.59	14.63
90	17.24	17.22	17.29	17.54	17.86	18.03	18.10	17.95	17.34	16.56	17.09	17.09
	17.30	17.27	17.35	17.57	17.92	18.11	18.21	18.03	17.42	16.65	17.11	17.15
91	20.30	20.30	20.52	20.84	21.27	21.59	21.67	21.50	20.59	19.46	20.05	20.15
	20.40	20.37	20.52	20.88	21.35	21.67	21.75	21.58	20.68	19.52	20.13	20.19
92	23.68	23.89	24.17	24.67	25.29	25.71	25.73	25.42	24.29	22.76	23.53	23.63
	23.69	23.94	24.24	24.78	25.33	25.79	25.80	25.57	24.40	22.85	23.60	23.73
93	---	27.28	27.82	28.35	29.07	29.53	29.46	28.86	27.56	26.26	27.12	---
	---	27.31	27.84	28.39	29.22	29.55	29.36	28.95	27.66	26.36	27.11	---
94	---	29.55	30.10	30.67	31.36	31.58	31.00	30.19	29.32	28.94	29.68	---
	---	29.66	30.15	30.77	31.45	31.71	31.05	30.27	29.49	28.97	29.73	---

49 **Table S8** Monthly averaged O3 AMFs for Marambio for sunset (pm). Green background is for values
50 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

51

52 **S3. Belgrano monthly averaged AMF values:**

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	5.40	5.16	---	---	5.29	5.11
	5.68	5.40	---	---	5.48	5.37
81	5.82	5.53	---	---	5.53	5.46
	6.11	5.77	---	---	5.72	5.74
82	6.34	5.94	6.02	---	6.01	5.83
	6.65	6.20	6.25	---	6.19	6.11
83	6.88	6.43	7.53	---	6.51	6.21
	7.18	6.69	7.79	---	6.71	6.51
84	7.39	6.96	7.48	---	7.08	6.69
	7.71	7.23	7.71	---	7.28	6.98
85	7.85	7.55	7.69	---	7.75	7.20
	8.18	7.82	7.93	---	7.97	7.49
86	8.33	8.24	8.92	---	8.66	7.73
	8.64	8.52	9.15	---	8.88	8.03
87	8.45	8.95	9.21	---	9.37	8.03
	8.76	9.23	9.48	---	9.62	8.32
88	7.89	9.61	11.00	---	10.18	8.30
	8.21	9.98	11.28	---	10.43	8.62
89	6.36	10.06	12.64	---	10.84	8.11
	6.65	10.45	13.07	---	11.08	8.39
90	4.26	8.97	11.07	---	10.83	7.34

	4.49	9.48	11.55	---	11.15	7.67
91	3.01	5.58	6.67	11.29	9.94	6.07
	3.19	6.29	7.19	11.53	10.17	6.41
92	1.76	3.15	3.42	8.75	6.80	3.96
	1.88	3.94	3.92	9.01	7.06	4.28
93	0.72	3.10	2.29	4.74	3.53	2.50
	0.77	3.85	2.66	4.97	3.77	2.82
94	0.36	3.44	2.21	3.33	2.72	2.23
	0.40	4.17	2.57	3.56	2.93	2.46

53 **Table S9** Monthly averaged OCIO AMFs for Belgrano for sunrise (am). Green background is for values
54 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

55

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	5.11	5.11	---	---	5.30	5.13
	5.38	5.33	---	---	5.49	5.37
81	5.48	5.45	---	---	5.53	5.49
	5.75	5.66	---	---	5.73	5.75
82	5.87	5.87	6.02	---	6.00	5.87
	6.16	6.11	6.25	---	6.18	6.12
83	6.33	6.50	7.36	---	6.53	6.26
	6.60	6.73	7.61	---	6.72	6.53
84	6.86	7.10	7.22	---	7.07	6.73
	7.16	7.34	7.45	---	7.28	7.02
85	7.45	7.75	7.34	---	7.77	7.28
	7.76	8.00	7.57	---	7.99	7.56
86	8.09	8.44	8.15	---	8.66	7.80
	8.40	8.72	8.38	---	8.93	8.10
87	8.53	9.03	8.42	---	9.39	8.14
	8.84	9.32	8.64	---	9.64	8.43
88	8.95	9.77	9.59	---	10.22	8.45
	9.31	10.07	9.78	---	10.48	8.76
89	9.18	10.25	10.34	---	10.93	8.26
	9.59	10.52	10.62	---	11.15	8.59
90	8.53	9.72	9.28	---	10.86	7.56
	8.99	10.06	9.62	---	11.07	7.88
91	7.85	8.54	7.21	11.04	9.69	6.19
	8.31	8.91	7.58	11.29	9.98	6.51
92	7.35	6.39	4.73	8.10	6.68	3.86
	7.86	6.75	5.05	8.34	6.95	4.16
93	7.49	5.36	3.42	5.49	4.52	2.97
	8.04	5.69	3.70	5.70	4.76	3.25
94	6.37	4.71	2.80	4.07	3.46	2.52
	6.93	5.03	3.08	4.28	3.67	2.78

56 **Table S10** Monthly averaged OCIO AMFs for Belgrano for sunset (pm). Green background is for values
57 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

58

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	4.86	5.08	---	---	5.20	5.19

	5.14	5.34	---	---	5.41	5.39
81	5.20	5.45	---	---	5.56	5.57
	5.48	5.70	---	---	5.77	5.78
82	5.60	5.86	---	---	6.01	6.03
	5.89	6.12	---	---	6.21	6.22
83	6.08	6.37	---	---	6.56	6.55
	6.36	6.64	---	---	6.74	6.76
84	6.62	6.95	---	---	7.19	7.19
	6.91	7.23	---	---	7.39	7.39
85	7.24	7.63	---	---	7.92	7.93
	7.53	7.90	---	---	8.14	8.13
86	8.07	8.49	---	---	8.85	8.80
	8.37	8.76	---	---	9.06	9.03
87	9.15	9.61	---	---	9.92	9.89
	9.47	9.89	---	---	10.15	10.11
88	10.41	11.04	10.86	---	11.17	11.12
	10.74	11.28	11.14	---	11.41	11.38
89	12.30	12.95	12.76	---	12.51	12.54
	12.64	13.26	13.07	---	12.72	12.77
90	15.22	16.13	15.43	---	14.04	14.19
	15.64	16.42	15.68	---	14.28	14.46
91	---	21.47	19.07	16.88	16.44	16.21
	---	21.73	19.40	17.15	16.70	16.48
92	---	34.02	27.63	21.07	21.26	20.10
	---	34.31	28.06	21.32	21.52	20.31
93	---	65.29	50.59	35.32	38.95	34.91
	---	65.82	51.26	35.91	39.47	35.44
94	---	110.33	78.12	67.27	77.92	54.98
	---	110.83	79.36	67.79	79.01	55.46

59 **Table S11** Monthly averaged BrO AMFs for Belgrano for sunrise (am). Green background is for values
60 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

61

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	5.02	5.10	---	---	5.20	5.19
	5.31	5.35	---	---	5.40	5.38
81	5.37	5.46	---	---	5.57	5.58
	5.66	5.72	---	---	5.76	5.77
82	5.76	5.86	---	---	6.01	6.04
	6.06	6.13	---	---	6.21	6.23
83	6.23	6.39	---	---	6.56	6.56
	6.52	6.66	---	---	6.76	6.76
84	6.76	6.95	---	---	7.19	7.19
	7.05	7.22	---	---	7.38	7.40
85	7.35	7.60	---	---	7.91	7.94
	7.64	7.88	---	---	8.14	8.14
86	8.07	8.39	---	---	8.86	8.81
	8.37	8.64	---	---	9.09	9.03
87	8.99	9.35	---	---	9.93	9.86
	9.30	9.63	---	---	10.17	10.10
88	10.01	10.51	10.57	---	11.18	11.15
	10.33	10.82	10.85	---	11.44	11.38

89	11.47	11.90	11.95	---	12.55	12.55
	11.78	12.19	12.26	---	12.80	12.83
90	13.64	13.70	13.26	---	13.90	14.16
	14.01	13.98	13.53	---	14.19	14.44
91	---	16.20	14.52	16.44	15.50	15.66
	---	16.55	14.83	16.65	15.76	15.91
92	---	21.78	16.87	18.48	17.04	17.30
	---	22.14	17.19	18.75	17.35	17.53
93	---	31.77	20.34	21.77	19.39	20.60
	---	32.22	20.66	22.01	19.79	20.74
94	---	48.35	25.87	27.38	23.59	25.50
	---	48.85	26.33	27.90	23.88	25.93

62 **Table S12** Monthly averaged BrO AMFs for Belgrano for sunset (pm). Green background is for values
63 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

64

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	5.32	5.32	---	---	5.02	5.11
	5.38	5.39	---	---	5.15	5.20
81	5.76	5.70	---	---	5.58	5.49
	5.82	5.77	---	---	5.71	5.59
82	6.28	6.19	---	---	6.08	5.98
	6.33	6.25	---	---	6.21	6.08
83	6.89	6.69	---	---	6.62	6.54
	6.93	6.75	---	---	6.75	6.64
84	7.61	7.38	---	---	7.41	7.23
	7.65	7.43	---	---	7.55	7.31
85	8.49	8.23	---	---	8.38	8.05
	8.52	8.27	---	---	8.52	8.13
86	9.54	9.25	---	---	9.21	9.05
	9.57	9.28	---	---	9.35	9.11
87	10.80	10.33	---	---	10.11	10.08
	10.82	10.36	---	---	10.25	10.17
88	12.50	11.67	13.54	---	11.28	11.35
	12.53	11.70	13.56	---	11.39	11.41
89	14.47	13.32	14.99	---	12.68	13.22
	14.51	13.37	15.03	---	12.82	13.32
90	16.98	15.41	17.06	---	14.29	15.64
	16.98	15.44	17.14	---	14.42	15.68
91	---	17.56	19.44	16.63	15.77	17.73
	---	17.61	19.49	16.84	15.87	17.80
92	---	19.35	21.54	17.97	16.96	19.64
	---	19.38	21.58	18.20	17.05	19.78
93	---	20.17	20.98	18.35	17.33	20.53
	---	20.12	20.94	18.46	17.44	20.62
94	---	21.11	20.63	18.31	18.13	21.67
	---	21.04	20.60	18.37	18.12	21.75

65 **Table S13** Monthly averaged NO₂ AMFs for Belgrano for sunrise (am). Green background is for values
66 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

67

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	5.14	5.28	---	---	5.07	5.12
	5.21	5.35	---	---	5.16	5.20
81	5.58	5.67	---	---	5.59	5.52
	5.63	5.72	---	---	5.69	5.59
82	6.09	6.15	---	---	6.08	6.02
	6.13	6.19	---	---	6.18	6.08
83	6.68	6.63	---	---	6.60	6.59
	6.73	6.67	---	---	6.69	6.66
84	7.40	7.31	---	---	7.41	7.30
	7.44	7.36	---	---	7.50	7.36
85	8.28	8.17	---	---	8.38	8.16
	8.31	8.21	---	---	8.47	8.20
86	9.33	9.19	---	---	9.14	9.16
	9.36	9.22	---	---	9.22	9.21
87	10.57	10.27	---	---	10.00	10.25
	10.59	10.31	---	---	10.08	10.30
88	12.21	11.66	13.13	---	11.20	11.60
	12.24	11.68	13.17	---	11.26	11.63
89	14.14	13.38	14.66	---	12.67	13.53
	14.17	13.38	14.67	---	12.73	13.57
90	16.58	15.48	16.80	---	14.40	15.94
	16.58	15.53	16.81	---	14.46	16.00
91	---	17.77	19.21	15.99	16.11	18.07
	---	17.78	19.24	16.13	16.13	18.11
92	---	19.71	21.43	17.36	17.57	20.21
	---	19.72	21.43	17.53	17.56	20.22
93	---	20.62	21.13	18.65	18.66	21.44
	---	20.56	21.12	18.75	18.69	21.34
94	---	21.68	21.12	19.65	20.13	22.89
	---	21.65	21.14	19.82	20.12	22.83

68 **Table S14** Monthly averaged NO₂ AMFs for Belgrano for sunset (pm). Green background is for values
69 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

70

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	5.10	5.11	---	---	4.94	4.92
	5.27	5.28	---	---	5.18	5.16
81	5.53	5.45	---	---	5.28	5.32
	5.70	5.61	---	---	5.52	5.56
82	6.06	5.94	---	---	5.76	5.81
	6.22	6.10	---	---	5.99	6.03
83	6.68	6.64	---	---	6.37	6.39
	6.83	6.79	---	---	6.58	6.59
84	7.42	7.44	---	---	7.08	7.08
	7.56	7.57	---	---	7.26	7.27
85	8.34	8.36	---	---	7.89	7.91
	8.47	8.49	---	---	8.06	8.09
86	9.48	9.52	---	---	9.17	8.93
	9.57	9.62	---	---	9.32	9.07
87	10.89	10.94	---	---	10.61	10.13
	10.97	11.03	---	---	10.74	10.27

88	12.68	12.75	13.24	---	12.33	11.61
	12.74	12.81	13.31	---	12.43	11.71
89	14.96	14.93	15.31	---	14.42	13.40
	15.04	15.01	15.43	---	14.52	13.50
90	17.64	17.67	18.16	---	17.01	15.56
	17.73	17.70	18.19	---	17.14	15.65
91	---	20.95	21.50	21.07	20.16	17.88
	---	21.01	21.56	21.17	20.25	17.98
92	---	24.67	25.56	25.22	23.71	20.73
	---	24.73	25.64	25.26	23.76	20.78
93	---	28.06	29.14	27.97	26.94	24.20
	---	28.12	29.25	28.16	27.02	24.29
94	---	30.02	31.07	29.01	28.96	27.88
	---	30.03	31.06	29.15	28.97	27.94

71 **Table S15** Monthly averaged O3 AMFs for Belgrano for sunrise (am). Green background is for values
72 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

73

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	5.08	5.10	---	---	4.93	4.92
	5.25	5.28	---	---	5.17	5.15
81	5.51	5.45	---	---	5.28	5.33
	5.68	5.62	---	---	5.52	5.56
82	6.04	5.94	---	---	5.77	5.81
	6.21	6.11	---	---	5.98	6.03
83	6.67	6.64	---	---	6.37	6.39
	6.82	6.79	---	---	6.59	6.60
84	7.41	7.44	---	---	7.07	7.09
	7.56	7.57	---	---	7.26	7.27
85	8.34	8.36	---	---	7.89	7.93
	8.47	8.49	---	---	8.06	8.08
86	9.49	9.52	---	---	9.17	8.93
	9.58	9.63	---	---	9.34	9.08
87	10.91	10.95	---	---	10.61	10.16
	10.99	11.03	---	---	10.75	10.29
88	12.71	12.74	13.22	---	12.32	11.62
	12.76	12.80	13.32	---	12.43	11.73
89	15.00	14.98	15.37	---	14.40	13.41
	15.08	15.00	15.45	---	14.51	13.51
90	17.69	17.60	18.10	---	16.96	15.56
	17.78	17.68	18.19	---	17.06	15.64
91	---	20.95	21.50	21.11	20.08	17.86
	---	20.99	21.57	21.16	20.16	17.96
92	---	24.69	25.64	25.26	23.57	20.65
	---	24.77	25.66	25.27	23.69	20.70
93	---	28.06	29.30	28.01	26.84	24.31
	---	28.14	29.17	28.20	26.93	24.38
94	---	30.09	31.08	29.03	28.85	28.03
	---	30.16	31.08	29.15	28.97	28.11

74 **Table S16** Monthly averaged O3 AMFs for Belgrano for sunset (pm). Green background is for values
75 obtained with surface albedo = 0.0, and white background for surface albedo = 1.0.

76 **S4. Marambio monthly averaged VCD values:**

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	6.24E10	9.68E10	1.63E11	3.11E11	---	---	---	6.53E12	5.23E12	1.39E12	1.13E11	7.32E10
81	5.94E10	9.18E10	1.54E11	2.93E11	---	---	---	7.05E12	5.36E12	1.42E12	1.08E11	7.00E10
82	5.59E10	8.59E10	1.42E11	2.73E11	---	---	---	7.78E12	5.51E12	1.45E12	1.03E11	6.61E10
83	5.25E10	8.01E10	1.31E11	2.53E11	4.80E11	---	---	8.07E12	5.74E12	1.50E12	9.72E10	6.25E10
84	4.88E10	7.36E10	1.18E11	2.29E11	4.60E11	---	---	8.41E12	5.98E12	1.56E12	9.10E10	5.87E10
85	4.45E10	6.59E10	1.03E11	2.02E11	4.55E11	---	---	8.78E12	6.24E12	1.61E12	8.37E10	5.42E10
86	3.90E10	5.67E10	8.68E10	1.72E11	1.18E12	---	8.87E12	9.18E12	6.52E12	1.67E12	7.43E10	4.84E10
87	3.41E10	4.85E10	7.22E10	1.48E11	1.23E12	---	1.02E13	1.00E13	7.11E12	1.81E12	6.61E10	4.33E10
88	2.90E10	4.03E10	5.80E10	1.25E11	1.32E12	6.17E12	1.18E13	1.11E13	7.87E12	1.99E12	5.78E10	3.81E10
89	2.39E10	3.36E10	4.87E10	1.14E11	1.46E12	6.93E12	1.33E13	1.24E13	8.83E12	2.25E12	5.02E10	3.29E10
90	2.01E10	3.85E10	6.68E10	1.92E11	1.81E12	8.09E12	1.559E13	1.43E13	1.02E13	2.60E12	5.06E10	2.82E10
91	2.19E10	7.41E10	1.58E11	6.18E11	3.27E12	1.07E13	2.04E13	2.00E13	1.55E13	3.94E12	7.88E10	2.55E10
92	3.47E10	1.53E11	3.61E11	1.87E12	9.26E12	2.04E13	3.74E13	4.05E13	3.52E13	1.00E13	1.59E11	2.91E10
93	5.69E10	2.55E11	6.33E11	4.07E12	2.53E13	5.58E13	9.25E13	9.37E13	8.16E13	2.44E13	2.77E11	---
94	9.96E10	3.80E11	8.94E11	5.66E12	3.88E13	9.07E13	1.45E14	1.37E14	1.17E14	3.49E13	4.51E11	---

77 **Table S17. Monthly averaged OCIO VCDs for Marambio for sunrise (am).**

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	7.49E10	9.02E10	1.64E11	3.36E11	---	---	---	6.44E12	4.92E12	1.31E12	1.19E11	8.63E10
81	7.25E10	8.81E10	1.62E11	3.35E11	---	---	---	6.94E12	5.04E12	1.34E12	1.16E11	8.40E10
82	7.01E10	8.61E10	1.60E11	3.35E11	---	---	---	7.65E12	5.19E12	1.37E12	1.14E11	8.18E10
83	6.78E10	8.44E10	1.59E11	3.38E11	5.90E11	---	---	7.91E12	5.40E12	1.43E12	1.12E11	7.97E10
84	6.46E10	8.19E10	1.57E11	3.40E11	6.05E11	---	---	8.23E12	5.64E12	1.49E12	1.09E11	7.68E10
85	6.10E10	7.90E10	1.55E11	3.42E11	6.47E11	---	---	8.58E12	5.90E12	1.56E12	1.06E11	7.33E10
86	5.74E10	7.62E10	1.53E11	3.47E11	1.42E12	---	8.77E12	9.03E12	6.24E12	1.65E12	1.02E11	6.98E10
87	5.41E10	7.46E10	1.56E11	3.68E11	1.57E12	---	1.02E13	9.94E12	6.92E12	1.84E12	1.01E11	6.69E10
88	4.89E10	7.14E10	1.58E11	3.92E11	1.76E12	6.34E12	1.18E13	1.11E13	7.81E12	2.08E12	9.61E10	6.18E10
89	4.31E10	6.75E10	1.61E11	4.31E11	2.05E12	7.27E12	1.35E13	1.28E13	9.04E12	2.42E12	9.02E10	5.56E10
90	3.71E10	6.46E10	1.74E11	5.18E11	2.61E12	8.86E12	1.66E13	1.56E13	1.10E13	2.98E12	8.42E10	4.89E10
91	3.15E10	6.42E10	2.04E11	6.98E11	3.78E12	1.22E13	2.27E13	2.13E13	1.52E13	4.13E12	8.26E10	4.29E10
92	2.59E10	6.76E10	2.67E11	1.09E12	6.50E12	1.94E13	3.57E13	3.29E13	2.33E13	6.49E12	8.44E10	3.58E10
93	---	7.83E10	3.47E11	1.64E12	1.08E13	3.07E13	5.55E13	5.01E13	3.55E13	9.94E12	1.09E11	---
94	---	1.02E11	4.44E11	2.34E12	1.69E13	4.69E13	8.19E13	7.18E13	5.07E13	1.45E13	1.56E11	---

78 **Table S18. Monthly averaged OCIO VCDs for Marambio for sunset (pm).**

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	2.85E13	3.10E13	3.40E13	3.62E13	---	---	---	3.60E13	3.43E13	3.31E13	3.14E13	2.99E13
81	2.79E13	3.06E13	3.36E13	3.61E13	---	---	---	3.65E13	3.43E13	3.29E13	3.09E13	2.93E13
82	2.72E13	2.99E13	3.31E13	3.58E13	---	---	---	3.70E13	3.43E13	3.26E13	3.02E13	2.85E13
83	2.62E13	2.91E13	3.23E13	3.53E13	3.80E13	---	---	3.71E13	3.42E13	3.21E13	2.93E13	2.75E13
84	2.52E13	2.81E13	3.14E13	3.46E13	3.74E13	---	---	3.70E13	3.40E13	3.16E13	2.83E13	2.64E13
85	2.40E13	2.69E13	3.01E13	3.35E13	3.74E13	---	---	3.70E13	3.38E13	3.09E13	2.71E13	2.52E13
86	2.25E13	2.54E13	2.84E13	3.19E13	3.79E13	---	3.75E13	3.67E13	3.35E13	2.98E13	2.55E13	2.36E13
87	2.04E13	2.32E13	2.61E13	2.95E13	3.63E13	---	3.67E13	3.61E13	3.28E13	2.84E13	2.33E13	2.14E13
88	1.82E13	2.08E13	2.32E13	2.64E13	3.40E13	3.57E13	3.64E13	3.53E13	3.20E13	2.69E13	2.09E13	1.89E13
89	1.57E13	1.80E13	1.99E13	2.26E13	3.06E13	3.40E13	3.55E13	3.41E13	3.07E13	2.52E13	1.82E13	1.63E13
90	1.30E13	1.47E13	1.59E13	1.80E13	2.58E13	3.09E13	3.35E13	3.14E13	2.82E13	2.27E13	1.52E13	1.35E13
91	9.87E12	1.09E13	1.14E13	1.27E13	1.95E13	2.52E13	2.81E13	2.55E13	2.27E13	1.81E13	1.15E13	1.03E13
92	7.05E12	7.37E12	7.32E12	7.85E12	1.28E13	1.75E13	1.96E13	1.69E13	1.50E13	1.19E13	8.00E12	7.52E12
93	4.56E12	4.42E12	4.11E12	4.11E12	6.84E12	8.71E12	9.19E12	7.55E12	6.94E12	5.89E12	4.94E12	---
94	3.22E12	2.77E12	2.41E12	2.31E12	4.17E12	4.39E12	3.96E12	3.26E12	3.22E12	3.12E12	3.31E12	---

79 **Table S19. Monthly averaged BrO VCDs for Marambio for sunrise (am).**

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	2.81E13	2.82E13	3.09E13	3.40E13	---	---	---	3.57E13	3.34E13	3.17E13	2.96E13	2.92E13
81	2.75E13	2.78E13	3.06E13	3.37E13	---	---	---	3.62E13	3.34E13	3.16E13	2.91E13	2.87E13
82	2.69E13	2.73E13	3.02E13	3.35E13	---	---	---	3.66E13	3.33E13	3.14E13	2.86E13	2.81E13
83	2.60E13	2.66E13	2.96E13	3.30E13	3.66E13	---	---	3.66E13	3.32E13	3.10E13	2.78E13	2.73E13
84	2.49E13	2.58E13	2.89E13	3.25E13	3.59E13	---	---	3.65E13	3.31E13	3.06E13	2.70E13	2.63E13
85	2.38E13	2.49E13	2.82E13	3.20E13	3.60E13	---	---	3.63E13	3.29E13	3.02E13	2.60E13	2.52E13
86	2.25E13	2.38E13	2.73E13	3.13E13	3.70E13	---	3.70E13	3.62E13	3.27E13	2.96E13	2.48E13	2.40E13
87	2.06E13	2.22E13	2.59E13	3.02E13	3.63E13	---	3.63E13	3.56E13	3.22E13	2.86E13	2.30E13	2.21E13
88	1.83E13	2.02E13	2.41E13	2.87E13	3.53E13	3.57E13	3.59E13	3.49E13	3.14E13	2.71E13	2.08E13	1.97E13
89	1.58E13	1.79E13	2.19E13	2.68E13	3.41E13	3.48E13	3.51E13	3.40E13	3.06E13	2.54E13	1.82E13	1.71E13
90	1.32E13	1.53E13	1.93E13	2.45E13	3.26E13	3.38E13	3.42E13	3.30E13	2.95E13	2.32E13	1.53E13	1.42E13
91	1.02E13	1.22E13	1.60E13	2.14E13	3.02E13	3.17E13	3.20E13	3.09E13	2.75E13	2.02E13	1.20E13	1.11E13
92	7.37E12	9.04E12	1.23E13	1.76E13	2.67E13	2.86E13	2.86E13	2.77E13	2.48E13	1.67E13	8.80E12	7.93E12
93	---	6.31E12	8.90E12	1.36E13	2.25E13	2.42E13	2.37E13	2.33E13	2.10E13	1.31E13	6.20E12	---
94	---	4.47E12	6.31E12	1.02E13	1.84E13	1.97E13	1.88E13	1.89E13	1.75E13	1.02E13	4.47E12	---

80 Table S20. Monthly averaged BrO VCDs for Marambio for sunset (pm).

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	4.45E15	3.07E15	2.26E15	1.54E15	---	---	---	7.24E14	9.62E14	1.22E15	2.99E15	4.30E15
81	4.49E15	3.08E15	2.26E15	1.53E15	---	---	---	7.16E14	9.61E14	1.23E15	3.01E15	4.34E15
82	4.53E15	3.10E15	2.27E15	1.52E15	---	---	---	6.95E14	9.60E14	1.23E15	3.04E15	4.39E15
83	4.59E15	3.13E15	2.29E15	1.52E15	9.59E14	---	---	6.86E14	9.62E14	1.24E15	3.07E15	4.45E15
84	4.66E15	3.17E15	2.31E15	1.53E15	9.30E14	---	---	6.80E14	9.66E14	1.26E15	3.11E15	4.52E15
85	4.73E15	3.20E15	2.33E15	1.53E15	9.02E14	---	---	6.74E14	9.70E14	1.27E15	3.15E15	4.59E15
86	4.81E15	3.25E15	2.36E15	1.55E15	8.19E14	---	6.01E14	6.70E14	9.76E14	1.29E15	3.21E15	4.67E15
87	4.95E15	3.34E15	2.42E15	1.58E15	8.11E14	---	5.43E14	6.73E14	9.95E14	1.33E15	3.30E15	4.81E15
88	5.11E15	3.44E15	2.50E15	1.62E15	8.11E14	6.20E14	5.29E14	6.79E14	1.02E15	1.38E15	3.41E15	4.96E15
89	5.28E15	3.55E15	2.58E15	1.67E15	8.17E14	6.07E14	5.29E14	6.89E14	1.05E15	1.44E15	3.54E15	5.14E15
90	5.48E15	3.69E15	2.68E15	1.73E15	8.30E14	6.04E14	5.33E14	7.03E14	1.09E15	1.53E15	3.70E15	5.34E15
91	5.84E15	3.93E15	2.88E15	1.88E15	8.86E14	6.31E14	5.57E14	7.47E14	1.19E15	1.69E15	3.97E15	5.68E15
92	6.30E15	4.27E15	3.19E15	2.13E15	1.01E15	6.99E14	6.12E14	8.45E14	1.36E15	1.93E15	4.34E15	6.11E15
93	6.99E15	4.81E15	3.73E15	2.64E15	1.33E15	9.07E14	7.87E14	1.13E15	1.74E15	2.31E15	4.83E15	---
94	7.27E15	5.29E15	4.25E15	3.19E15	1.74E15	1.21E15	1.06E15	1.46E15	2.07E15	2.60E15	5.26E15	---

81 Table S21. Monthly averaged NO2 VCDs for Marambio for sunrise (am).

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	5.26E15	4.20E15	3.10E15	1.92E15	---	---	---	8.21E14	1.18E15	1.57E15	3.66E15	4.55E15
81	5.31E15	4.24E15	3.13E15	1.94E15	---	---	---	8.24E14	1.19E15	1.58E15	3.69E15	4.59E15
82	5.36E15	4.29E15	3.17E15	1.97E15	---	---	---	8.11E14	1.20E15	1.60E15	3.73E15	4.63E15
83	5.43E15	4.35E15	3.22E15	2.01E15	1.14E15	---	---	8.21E14	1.22E15	1.63E15	3.78E15	4.69E15
84	5.50E15	4.42E15	3.27E15	2.04E15	1.13E15	---	---	8.33E14	1.24E15	1.65E15	3.83E15	4.76E15
85	5.57E15	4.49E15	3.33E15	2.08E15	1.13E15	---	---	8.45E14	1.25E15	1.68E15	3.89E15	4.82E15
86	5.66E15	4.57E15	3.39E15	2.12E15	1.06E15	---	6.97E14	8.58E14	1.27E15	1.71E15	3.96E15	4.90E15
87	5.81E15	4.70E15	3.50E15	2.19E15	1.10E15	---	6.46E14	8.80E14	1.31E15	1.77E15	4.07E15	5.03E15
88	5.98E15	4.85E15	3.62E15	2.26E15	1.14E15	7.32E14	6.57E14	9.03E14	1.35E15	1.84E15	4.21E15	5.18E15
89	6.15E15	5.02E15	3.74E15	2.35E15	1.18E15	7.69E14	6.78E14	9.28E14	1.40E15	1.92E15	4.36E15	5.34E15
90	6.36E15	5.21E15	3.90E15	2.45E15	1.22E15	8.03E14	7.02E14	9.59E14	1.45E15	2.03E15	4.54E15	5.53E15
91	6.71E15	5.56E15	4.19E15	2.65E15	1.32E15	8.67E14	7.50E14	1.03E15	1.58E15	2.22E15	4.85E15	5.84E15
92	7.16E15	6.03E15	4.62E15	2.98E15	1.50E15	9.79E14	8.41E14	1.16E15	1.79E15	2.50E15	5.26E15	6.25E15
93	---	6.75E15	5.33E15	3.61E15	1.89E15	1.23E15	1.06E15	1.47E15	2.19E15	2.93E15	5.81E15	---
94	---	7.34E15	5.97E15	4.24E15	2.35E15	1.56E15	1.34E15	1.79E15	2.54E15	3.25E15	6.24E15	---

82 Table S22. Monthly averaged NO2 VCDs for Marambio for sunset (pm).

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	8.35E18	8.14E18	8.11E18	7.81E18	---	---	---	6.87E18	5.74E18	4.83E18	7.46E18	8.45E18
81	8.35E18	8.15E18	8.12E18	7.81E18	---	---	---	7.01E18	5.74E18	4.83E18	7.46E18	8.45E18
82	8.35E18	8.15E18	8.12E18	7.81E18	---	---	---	7.12E18	5.74E18	4.83E18	7.46E18	8.45E18
83	8.36E18	8.15E18	8.12E18	7.81E18	7.72E18	---	---	7.16E18	5.74E18	4.83E18	7.47E18	8.46E18
84	8.36E18	8.15E18	8.12E18	7.81E18	7.67E18	---	---	7.16E18	5.74E18	4.83E18	7.47E18	8.46E18
85	8.36E18	8.15E18	8.12E18	7.81E18	7.75E18	---	---	7.16E18	5.74E18	4.84E18	7.47E18	8.46E18
86	8.37E18	8.15E18	8.12E18	7.81E18	7.79E18	---	8.03E18	7.16E18	5.75E18	4.84E18	7.47E18	8.47E18
87	8.37E18	8.16E18	8.12E18	7.81E18	7.79E18	---	7.95E18	7.16E18	5.75E18	4.84E18	7.47E18	8.47E18
88	8.37E18	8.16E18	8.13E18	7.82E18	7.79E18	7.86E18	7.98E18	7.17E18	5.75E18	4.84E18	7.48E18	8.47E18
89	8.38E18	8.16E18	8.13E18	7.82E18	7.79E18	7.86E18	7.99E18	7.17E18	5.75E18	4.84E18	7.48E18	8.48E18
90	8.38E18	8.16E18	8.13E18	7.82E18	7.79E18	7.86E18	7.99E18	7.17E18	5.75E18	4.84E18	7.48E18	8.48E18
91	8.38E18	8.17E18	8.13E18	7.82E18	7.79E18	7.87E18	7.99E18	7.17E18	5.75E18	4.85E18	7.49E18	8.49E18
92	8.39E18	8.17E18	8.13E18	7.82E18	7.79E18	7.87E18	7.99E18	7.17E18	5.76E18	4.85E18	7.49E18	8.50E18
93	8.39E18	8.17E18	8.13E18	7.82E18	7.80E18	7.87E18	7.99E18	7.18E18	5.76E18	4.85E18	7.49E18	---
94	8.26E18	8.17E18	8.14E18	7.82E18	7.80E18	7.87E18	7.99E18	7.18E18	5.76E18	4.85E18	7.50E18	---

83 Table S23. Monthly averaged O3 VCDs for Marambio for sunrise (am).

SZA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80	9.17E18	8.18E18	8.13E18	7.82E18	---	---	---	6.86E18	5.73E18	4.92E18	7.53E18	8.49E18
81	9.16E18	8.17E18	8.13E18	7.81E18	---	---	---	6.99E18	5.73E18	4.92E18	7.53E18	8.49E18
82	9.16E18	8.17E18	8.13E18	7.81E18	---	---	---	7.10E18	5.73E18	4.92E18	7.53E18	8.49E18
83	9.16E18	8.17E18	8.13E18	7.81E18	7.72E18	---	---	7.13E18	5.73E18	4.92E18	7.53E18	8.48E18
84	9.15E18	8.17E18	8.13E18	7.81E18	7.67E18	---	---	7.13E18	5.73E18	4.91E18	7.52E18	8.48E18
85	9.15E18	8.17E18	8.13E18	7.81E18	7.76E18	---	---	7.13E18	5.73E18	4.91E18	7.52E18	8.48E18
86	9.15E18	8.16E18	8.13E18	7.81E18	7.79E18	---	8.01E18	7.13E18	5.73E18	4.91E18	7.52E18	8.47E18
87	9.14E18	8.16E18	8.12E18	7.81E18	7.79E18	---	7.93E18	7.13E18	5.73E18	4.91E18	7.52E18	8.47E18
88	9.14E18	8.16E18	8.12E18	7.81E18	7.79E18	7.85E18	7.96E18	7.12E18	5.72E18	4.91E18	7.51E18	8.46E18
89	9.14E18	8.16E18	8.12E18	7.81E18	7.79E18	7.85E18	7.95E18	7.12E18	5.72E18	4.91E18	7.51E18	8.46E18
90	9.13E18	8.16E18	8.12E18	7.81E18	7.79E18	7.85E18	7.95E18	7.12E18	5.72E18	4.91E18	7.51E18	8.46E18
91	9.12E18	8.15E18	8.12E18	7.81E18	7.79E18	7.85E18	7.95E18	7.12E18	5.72E18	4.91E18	7.51E18	8.45E18
92	9.12E18	8.15E18	8.12E18	7.81E18	7.79E18	7.85E18	7.95E18	7.12E18	5.72E18	4.91E18	7.50E18	8.44E18
93	---	8.15E18	8.12E18	7.81E18	7.79E18	7.85E18	7.95E18	7.12E18	5.72E18	4.91E18	7.50E18	---
94	---	8.15E18	8.12E18	7.81E18	7.79E18	7.85E18	7.95E18	7.12E18	5.72E18	4.91E18	7.50E18	---

84 Table S24. Monthly averaged O3 VCDs for Marambio for sunset (pm).

85 **S5. Belgrano monthly averaged VCD values:**

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	7.54E+10	2.06E+11	---	---	8.29E+12	1.90E+12
81	7.29E+10	2.08E+11	---	---	8.85E+12	1.98E+12
82	6.99E+10	2.06E+11	---	---	9.43E+12	2.08E+12
83	6.76E+10	1.96E+11	---	---	1.00E+13	2.23E+12
84	6.57E+10	1.82E+11	---	---	1.08E+13	2.40E+12
85	6.41E+10	1.65E+11	---	---	1.16E+13	2.60E+12
86	6.25E+10	1.43E+11	---	---	1.22E+13	2.82E+12
87	6.48E+10	1.23E+11	---	---	1.34E+13	3.26E+12
88	7.35E+10	1.02E+11	3.42E+11	---	1.49E+13	3.85E+12
89	9.31E+10	8.37E+10	2.90E+11	---	1.71E+13	4.82E+12
90	1.40E+11	7.62E+10	3.20E+11	---	2.01E+13	6.24E+12
91	---	1.10E+11	5.57E+11	2.81E+13	2.57E+13	8.72E+12
92	---	3.15E+11	1.69E+12	3.74E+13	3.89E+13	1.46E+13
93	---	7.62E+11	6.45E+12	7.68E+13	9.43E+13	3.69E+13
94	---	1.13E+12	1.14E+13	1.33E+14	1.58E+14	7.24E+13

86 Table S25. Monthly averaged OCIO VCDs for Belgrano for sunrise (am).

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	7.96E+10	2.01E+11	---	---	7.97E+12	1.69E+12
81	7.75E+10	2.07E+11	---	---	8.51E+12	1.75E+12
82	7.55E+10	2.14E+11	---	---	9.07E+12	1.83E+12
83	7.35E+10	2.13E+11	---	---	9.62E+12	1.95E+12
84	7.07E+10	2.11E+11	---	---	1.03E+13	2.08E+12
85	6.76E+10	2.09E+11	---	---	1.11E+13	2.23E+12
86	6.43E+10	2.07E+11	---	---	1.17E+13	2.42E+12
87	6.41E+10	2.12E+11	---	---	1.28E+13	2.80E+12
88	6.48E+10	2.16E+11	6.27E+11	---	1.43E+13	3.31E+12
89	6.45E+10	2.24E+11	6.71E+11	---	1.64E+13	4.15E+12
90	6.98E+10	2.52E+11	8.64E+11	---	1.96E+13	5.39E+12
91	---	2.97E+11	1.37E+12	2.91E+13	2.62E+13	7.88E+12
92	---	4.16E+11	2.49E+12	4.20E+13	3.95E+13	1.46E+13
93	---	5.22E+11	4.23E+12	6.27E+13	5.92E+13	2.25E+13
94	---	6.80E+11	7.27E+12	9.05E+13	8.71E+13	3.75E+13

87 **Table S26.** Monthly averaged OCIO VCDs for Belgrano for sunset (pm).

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	3.16E+13	3.50E+13	---	---	2.95E+13	2.64E+13
81	3.10E+13	3.48E+13	---	---	2.99E+13	2.66E+13
82	3.03E+13	3.46E+13	---	---	3.05E+13	2.68E+13
83	2.93E+13	3.41E+13	---	---	3.10E+13	2.71E+13
84	2.82E+13	3.34E+13	---	---	3.15E+13	2.73E+13
85	2.70E+13	3.25E+13	---	---	3.19E+13	2.76E+13
86	2.53E+13	3.10E+13	---	---	3.20E+13	2.77E+13
87	2.32E+13	2.87E+13	---	---	3.18E+13	2.77E+13
88	2.10E+13	2.58E+13	3.33E+13	---	3.16E+13	2.76E+13
89	1.79E+13	2.23E+13	2.97E+13	---	3.14E+13	2.74E+13
90	1.44E+13	1.79E+13	2.53E+13	---	3.07E+13	2.63E+13
91	---	1.27E+13	1.97E+13	2.80E+13	2.73E+13	2.34E+13
92	---	8.05E+12	1.35E+13	2.26E+13	2.08E+13	1.86E+13
93	---	4.19E+12	7.20E+12	1.27E+13	1.05E+13	1.00E+13
94	---	2.53E+12	4.68E+12	6.33E+12	4.94E+12	6.15E+12

88 **Table S27.** Monthly averaged BrO VCDs for Belgrano for sunrise (am).

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	3.06E+13	3.33E+13	---	---	2.88E+13	2.53E+13
81	3.00E+13	3.29E+13	---	---	2.92E+13	2.54E+13
82	2.95E+13	3.28E+13	---	---	2.97E+13	2.56E+13
83	2.86E+13	3.22E+13	---	---	3.02E+13	2.58E+13
84	2.76E+13	3.15E+13	---	---	3.06E+13	2.60E+13
85	2.65E+13	3.07E+13	---	---	3.10E+13	2.61E+13
86	2.53E+13	2.99E+13	---	---	3.11E+13	2.63E+13
87	2.36E+13	2.84E+13	---	---	3.09E+13	2.64E+13
88	2.18E+13	2.65E+13	3.35E+13	---	3.07E+13	2.64E+13
89	1.92E+13	2.41E+13	3.16E+13	---	3.04E+13	2.62E+13
90	1.61E+13	2.12E+13	3.00E+13	---	3.01E+13	2.57E+13
91	---	1.74E+13	2.79E+13	2.89E+13	2.88E+13	2.45E+13
92	---	1.30E+13	2.44E+13	2.62E+13	2.64E+13	2.23E+13
93	---	8.95E+12	1.99E+13	2.15E+13	2.21E+13	1.82E+13
94	---	6.00E+12	1.57E+13	1.62E+13	1.74E+13	1.41E+13

89 **Table S28.** Monthly averaged BrO VCDs for Belgrano for sunset (pm).

90

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	4.30E+15	2.34E+15	---	---	6.02E+14	1.01E+15
81	4.35E+15	2.30E+15	---	---	5.87E+14	1.02E+15
82	4.40E+15	2.27E+15	---	---	5.78E+14	1.03E+15
83	4.48E+15	2.29E+15	---	---	5.72E+14	1.04E+15
84	4.55E+15	2.31E+15	---	---	5.57E+14	1.06E+15
85	4.64E+15	2.33E+15	---	---	5.39E+14	1.07E+15
86	4.73E+15	2.36E+15	---	---	5.38E+14	1.09E+15
87	4.84E+15	2.44E+15	---	---	5.43E+14	1.12E+15
88	4.91E+15	2.52E+15	1.33E+15	---	5.50E+14	1.16E+15
89	5.02E+15	2.62E+15	1.34E+15	---	5.58E+14	1.17E+15
90	5.14E+15	2.74E+15	1.34E+15	---	5.69E+14	1.18E+15
91	---	3.01E+15	1.38E+15	2.86E+14	6.05E+14	1.26E+15
92	---	3.44E+15	1.51E+15	2.99E+14	6.83E+14	1.40E+15
93	---	4.24E+15	1.99E+15	3.54E+14	8.87E+14	1.73E+15
94	---	5.00E+15	2.57E+15	4.59E+14	1.12E+15	1.97E+15

91 **Table S29.** Monthly averaged NO2 VCDs for Belgrano for sunrise (am).

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	4.45E+15	2.60E+15	---	---	6.56E+14	1.08E+15
81	4.49E+15	2.57E+15	---	---	6.45E+14	1.09E+15
82	4.54E+15	2.57E+15	---	---	6.40E+14	1.10E+15
83	4.61E+15	2.62E+15	---	---	6.42E+14	1.12E+15
84	4.68E+15	2.67E+15	---	---	6.31E+14	1.14E+15
85	4.76E+15	2.72E+15	---	---	6.18E+14	1.15E+15
86	4.84E+15	2.77E+15	---	---	6.31E+14	1.17E+15
87	4.95E+15	2.88E+15	---	---	6.49E+14	1.21E+15
88	5.02E+15	2.99E+15	1.56E+15	---	6.68E+14	1.25E+15
89	5.14E+15	3.11E+15	1.58E+15	---	6.87E+14	1.26E+15
90	5.27E+15	3.25E+15	1.60E+15	---	7.11E+14	1.28E+15
91	---	3.57E+15	1.66E+15	3.65E+14	7.64E+14	1.37E+15
92	---	4.05E+15	1.81E+15	3.90E+14	8.60E+14	1.52E+15
93	---	4.94E+15	2.34E+15	4.54E+14	1.07E+15	1.85E+15
94	---	5.74E+15	2.95E+15	5.59E+14	1.30E+15	2.08E+15

92 **Table S30.** Monthly averaged NO2 VCDs for Belgrano for sunset (pm).

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	7.68E+18	7.06E+18	---	---	3.60E+18	3.06E+18
81	7.68E+18	7.16E+18	---	---	3.69E+18	3.06E+18
82	7.69E+18	7.27E+18	---	---	3.81E+18	3.06E+18
83	7.69E+18	7.27E+18	---	---	3.91E+18	3.06E+18
84	7.69E+18	7.27E+18	---	---	4.01E+18	3.06E+18
85	7.70E+18	7.27E+18	---	---	4.16E+18	3.07E+18
86	7.70E+18	7.27E+18	---	---	4.16E+18	3.07E+18
87	7.71E+18	7.27E+18	---	---	4.17E+18	3.07E+18
88	7.71E+18	7.27E+18	6.75E+18	---	4.17E+18	3.07E+18
89	7.67E+18	7.27E+18	6.77E+18	---	4.18E+18	3.06E+18
90	7.65E+18	7.28E+18	6.76E+18	---	4.18E+18	3.03E+18
91	---	7.28E+18	6.78E+18	5.81E+18	4.18E+18	3.02E+18
92	---	7.28E+18	6.75E+18	5.83E+18	4.19E+18	3.01E+18
93	---	7.28E+18	6.75E+18	6.00E+18	4.19E+18	2.99E+18
94	---	7.29E+18	6.75E+18	6.08E+18	4.19E+18	2.98E+18

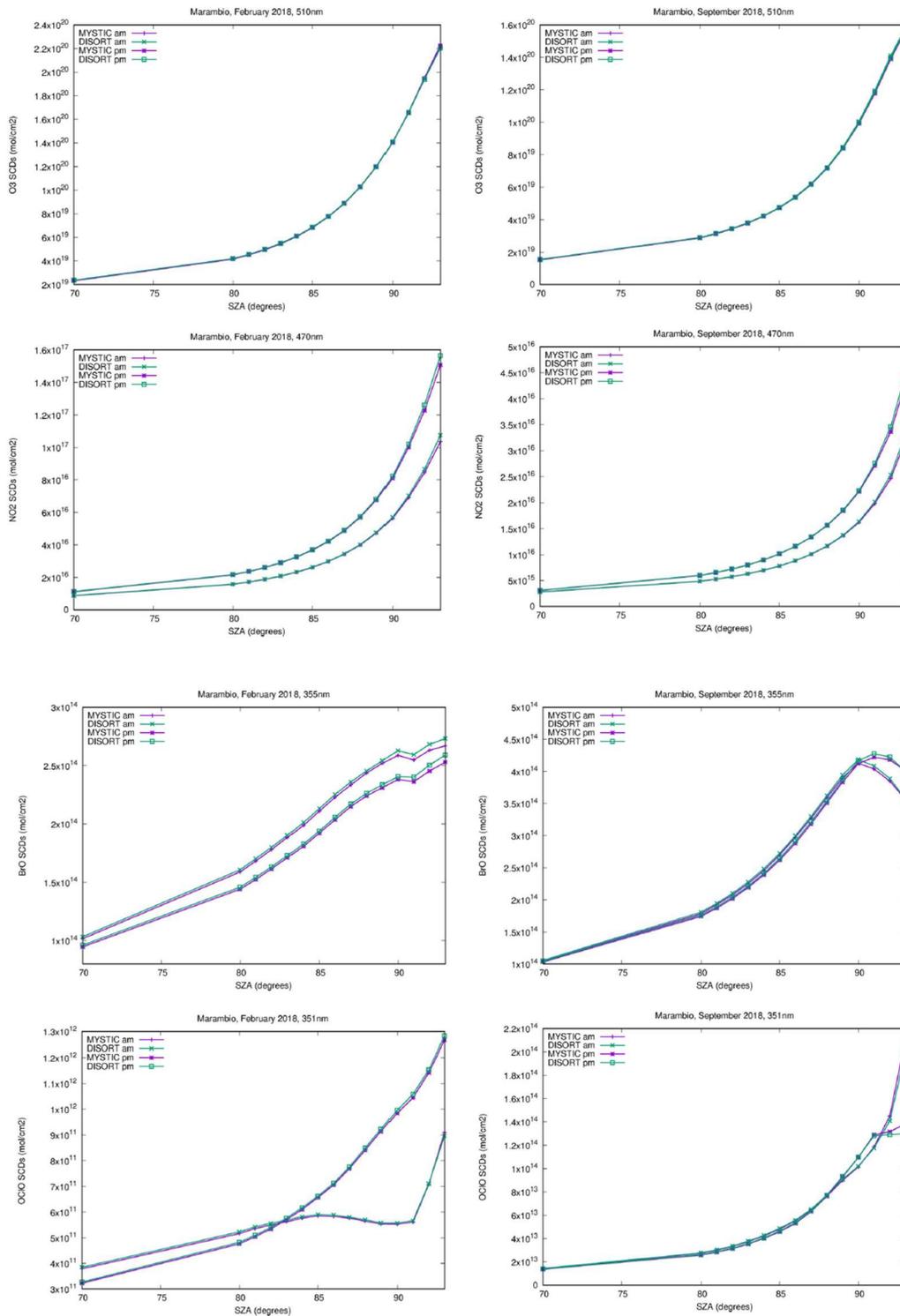
93 **Table S31.** Monthly averaged O3 VCDs for Belgrano for sunrise (am).

94

SZA	Feb	Mar	Apr	Aug	Sep	Oct
80	7.71E+18	7.08E+18	---	---	3.56E+18	3.09E+18
81	7.71E+18	7.18E+18	---	---	3.64E+18	3.08E+18
82	7.70E+18	7.28E+18	---	---	3.76E+18	3.08E+18
83	7.70E+18	7.28E+18	---	---	3.85E+18	3.08E+18
84	7.70E+18	7.28E+18	---	---	3.95E+18	3.08E+18
85	7.69E+18	7.28E+18	---	---	4.09E+18	3.08E+18
86	7.69E+18	7.28E+18	---	---	4.08E+18	3.07E+18
87	7.69E+18	7.28E+18	---	---	4.08E+18	3.07E+18
88	7.70E+18	7.27E+18	6.74E+18	---	4.07E+18	3.07E+18
89	7.65E+18	7.27E+18	6.76E+18	---	4.07E+18	3.05E+18
90	7.63E+18	7.27E+18	6.75E+18	---	4.07E+18	3.02E+18
91	---	7.27E+18	6.76E+18	5.76E+18	4.06E+18	3.00E+18
92	---	7.27E+18	6.73E+18	5.78E+18	4.06E+18	2.99E+18
93	---	7.27E+18	6.73E+18	5.95E+18	4.06E+18	2.97E+18
94	---	7.27E+18	6.73E+18	6.04E+18	4.06E+18	2.95E+18

95 **Table S32.** Monthly averaged O3 VCDs for Belgrano for sunset (pm).

96 **S6. 1D-DISORT – MYSTIC comparison:**



97

98

99 **Figure S5** SCD of O₃ (row 1), NO₂ (row 2), BrO (row 3) and OCIO (row 4) for Marambio, February (left)
 100 and September (right), obtained with MYSTIC (violet) and 1D-DISORT (green), by using the same inputs:
 101 monthly averaged profiles of the corresponding months.