

Appendix

Trade-offs between short-term mortality attributable to NO₂ and O₃ changes during the COVID-19 lockdown across major Spanish cities

Hicham Achebak^{1,2}, Hervé Petetin³, Marcos Quijal-Zamorano¹, Dene Bowdalo³, Carlos Pérez García-Pando^{3,4}, Joan Ballester¹

¹ Climate and Health Program, Barcelona Institute for Global Health, Barcelona, Spain

² Centre for Demographic Studies, Autonomous University of Barcelona, Barcelona, Spain

³ Barcelona Supercomputing Center, Barcelona, Spain

⁴ ICREA, Catalan Institution for Research and Advanced Studies, Barcelona, Spain

Correspondence to:

Hicham Achebak
Barcelona Institute for Global Health,
Carrer Doctor Aiguader 88,
08003 Barcelona, Catalonia, Spain
hicham.achebak@isglobal.org

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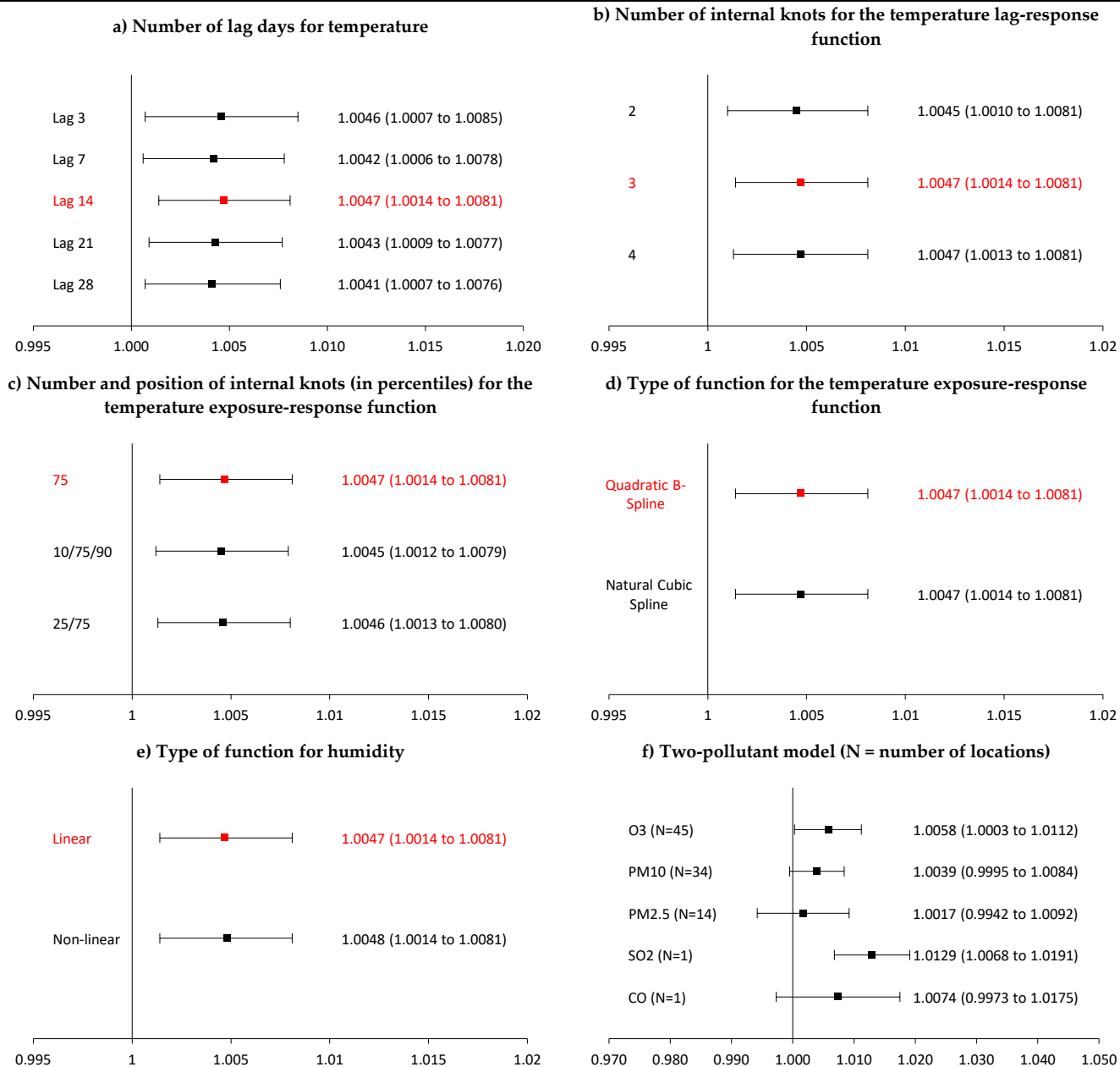


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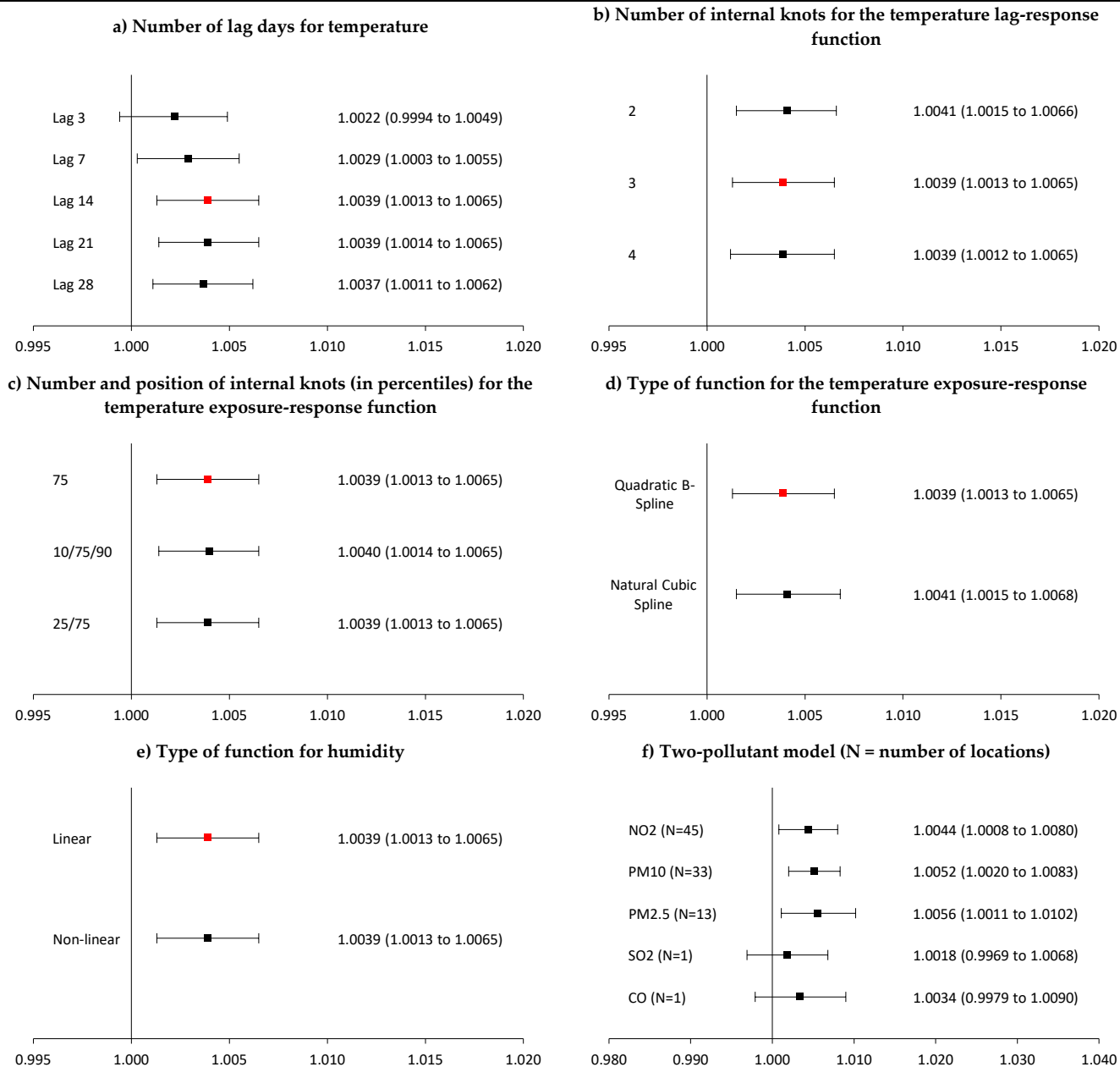


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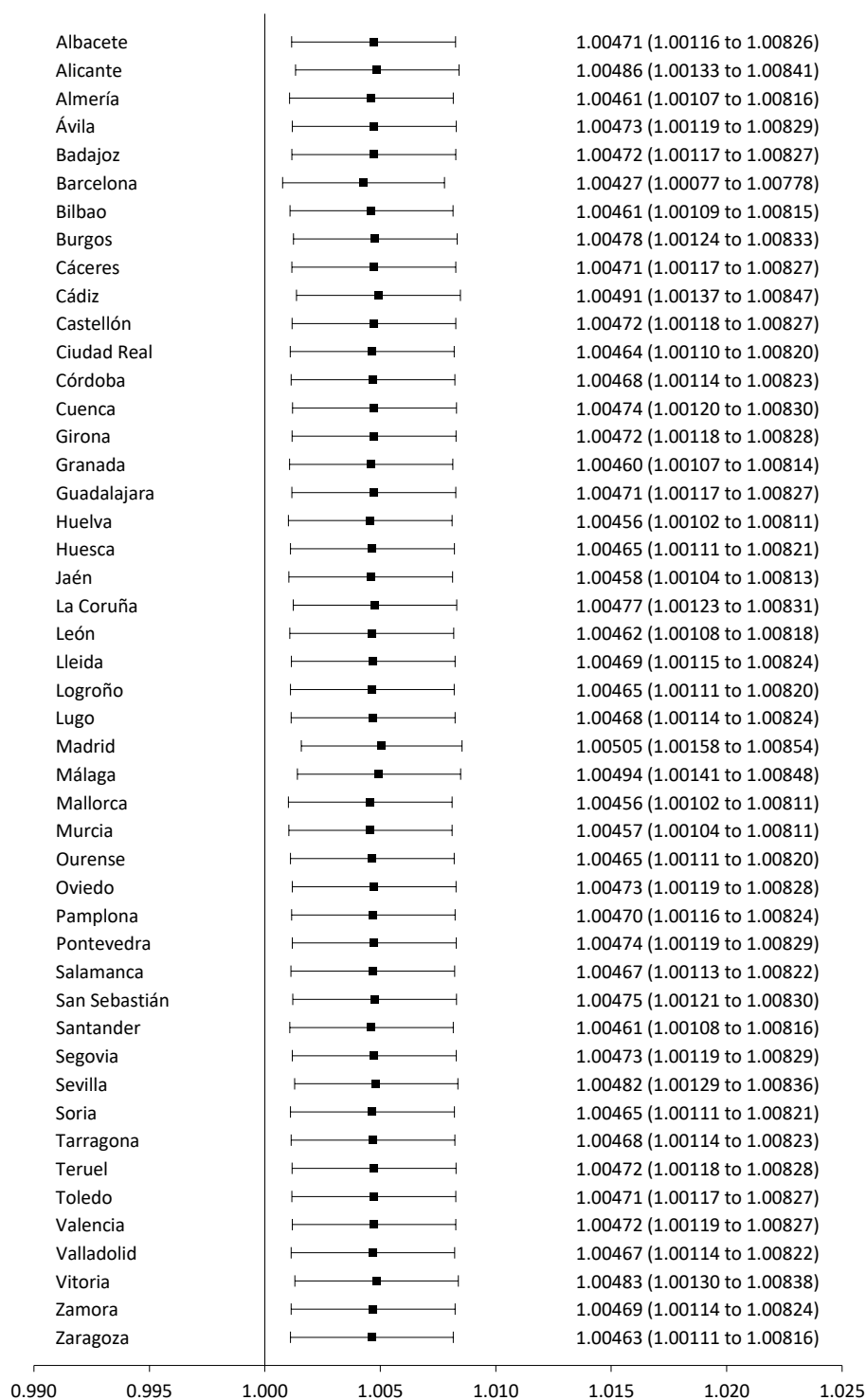


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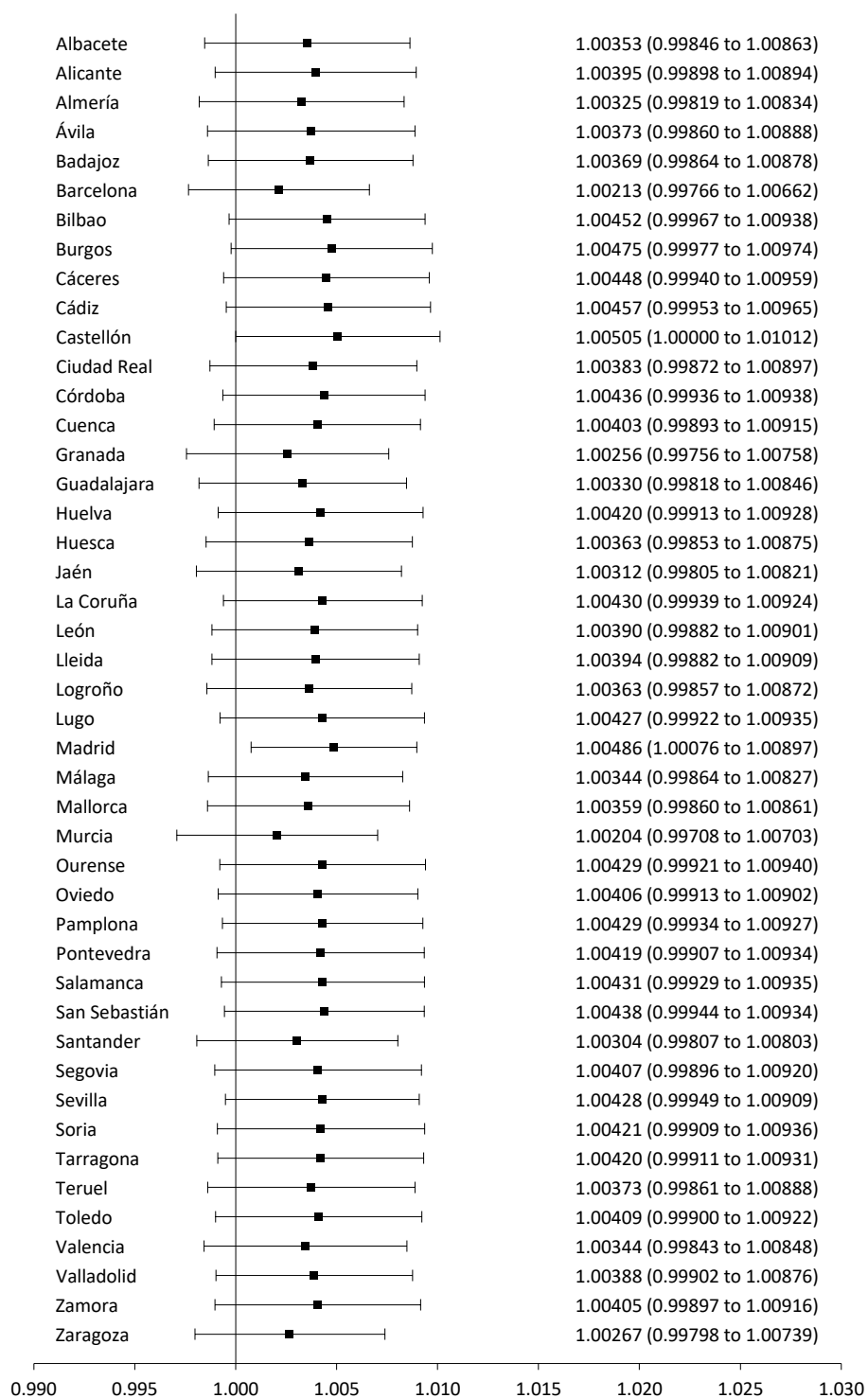


Table S1. Statistical results of the machine learning models for predicting business-as-usual NO₂ concentrations for both training and testing datasets. Metrics are Mean Bias (MB), normalized Mean Bias (nMB), Root Mean Square Error (RMSE), normalized Root Mean Square Error (nRMSE), Pearson Correlation Coefficient (PCC), Number of points (N).

City	Training						Testing					
	MB	nMB	RMSE	nRMSE	PCC	N	MB	nMB	RMSE	nRMSE	PCC	N
La Coruña	-0.01	-0.04	2.21	19.06	0.91	1,084	2.60	32.96	3.76	47.56	0.83	59
Albacete	0.00	0.03	0.73	9.67	0.99	954	3.61	38.83	4.81	51.72	0.71	59
Alicante	-0.01	-0.13	1.26	12.48	0.97	1,082	0.71	5.75	3.00	24.31	0.77	72
Almería	-0.01	-0.08	1.74	18.16	0.86	1,080	0.88	8.12	2.07	19.06	0.81	56
Vitoria	0.00	0.00	1.31	19.46	0.96	968	1.52	17.02	2.82	31.73	0.78	69
Oviedo	0.00	-0.03	2.36	19.53	0.90	1,092	0.31	1.91	3.00	18.74	0.77	73
Badajoz	0.00	0.01	1.43	27.93	0.89	977	0.31	5.95	1.29	25.02	0.81	71
Barcelona	-0.01	-0.03	3.11	15.42	0.90	1,092	0.96	4.80	4.61	23.13	0.75	73
Bilbao	0.00	0.00	1.66	11.58	0.96	1,087	2.51	17.77	4.30	30.35	0.72	70
Burgos	0.00	0.05	2.40	29.95	0.87	958	1.03	13.35	2.40	31.17	0.85	72
Santander	0.01	0.07	3.01	25.27	0.82	1,049	-0.83	-5.48	2.95	19.60	0.79	73
Castellón	-0.02	-0.20	1.86	19.30	0.92	1,087	2.16	18.78	3.77	32.68	0.70	72
Ciudad Real	0.00	-0.02	1.29	10.80	0.99	969	-3.19	-27.71	5.22	45.32	0.57	62
Cuenca	-0.01	-0.05	2.23	15.78	0.94	1,055	1.86	11.17	3.98	23.89	0.84	65
Cáceres	-0.01	-0.15	1.11	29.10	0.88	1,023	-0.20	-4.42	1.60	34.59	0.59	72
Cádiz	0.00	0.02	0.83	11.31	0.98	1,009	0.60	8.01	1.98	26.33	0.88	39
Córdoba	0.01	0.08	1.77	20.61	0.89	1,075	0.68	7.57	2.05	22.79	0.76	56
San Sebastián	0.00	0.01	2.37	19.19	0.87	1,058	1.12	8.38	2.88	21.60	0.78	70
Girona	0.01	0.05	2.30	15.51	0.90	1,041	2.09	13.94	3.29	21.99	0.72	73
Granada	-0.06	-0.26	4.24	20.17	0.83	1,061	-3.08	-11.84	7.01	26.94	0.57	54
Guadalajara	0.00	-0.01	2.37	22.30	0.92	978	-2.60	-20.46	3.85	30.28	0.81	58
Huelva	0.00	-0.03	2.42	29.96	0.78	1,072	0.19	1.89	2.27	22.66	0.79	73
Huesca	-0.01	-0.10	0.98	11.73	0.97	1,015	1.47	13.58	3.64	33.62	0.62	68
Jaén	0.00	-0.04	1.51	17.92	0.94	1,080	-0.17	-1.60	2.57	24.44	0.84	55
Logroño	-0.02	-0.14	2.37	21.89	0.86	1,078	-0.57	-4.82	3.25	27.42	0.48	73
León	0.01	0.10	2.36	23.57	0.89	1,055	1.36	10.87	3.04	24.38	0.81	72
Lleida	0.00	0.00	0.66	5.78	0.99	1,032	0.56	4.35	3.23	24.97	0.70	73
Lugo	0.00	-0.04	0.89	14.10	0.97	1,061	1.96	26.96	2.87	39.47	0.83	64
Madrid	0.00	-0.02	2.16	11.04	0.97	1,089	1.28	5.59	4.51	19.68	0.89	73
Mallorca	0.00	0.01	0.98	8.11	0.96	1,078	1.60	14.94	2.93	27.25	0.75	73
Murcia	-0.02	-0.09	3.15	17.11	0.91	1,004	-0.82	-3.29	4.24	16.96	0.57	70
Málaga	0.00	-0.03	2.11	16.65	0.91	1,081	0.67	4.83	2.78	19.95	0.83	56
Pamplona	-0.01	-0.05	2.91	24.70	0.88	1,090	1.57	9.84	4.27	26.83	0.70	73
Ourense	0.01	0.05	2.65	19.89	0.85	1,079	0.42	2.69	3.21	20.76	0.63	73
Pontevedra	0.00	0.00	0.74	6.55	0.99	1,061	0.08	0.81	2.33	23.06	0.85	71
Salamanca	0.02	0.21	2.25	30.44	0.87	988	-0.97	-10.97	2.60	29.55	0.76	71
Segovia	0.01	0.20	1.68	24.81	0.82	844	1.13	15.60	2.20	30.30	0.77	68
Sevilla	0.00	-0.03	1.26	8.95	0.97	1,082	0.70	4.81	3.13	21.60	0.77	56
Soria	0.00	0.04	2.88	26.49	0.83	992	-0.56	-4.51	2.73	21.92	0.89	72
Tarragona	0.00	-0.01	1.28	12.11	0.96	1,092	1.27	10.62	2.82	23.55	0.82	73
Teruel	0.00	-0.01	0.35	6.18	0.99	1,024	-1.56	-16.21	4.42	45.95	0.63	48
Toledo	0.01	0.10	1.29	11.84	0.97	1,050	1.09	8.56	3.23	25.46	0.79	65
Valencia	0.00	0.01	2.32	16.46	0.94	1,082	1.39	9.53	4.30	29.48	0.76	72
Valladolid	0.00	-0.02	1.96	16.69	0.93	1,063	0.34	2.78	2.85	23.04	0.78	63
Zamora	0.00	0.04	0.82	11.42	0.98	580	0.97	12.54	2.69	34.82	0.65	63
Zaragoza	0.01	0.06	2.10	16.25	0.94	1,057	-1.38	-8.48	3.21	19.75	0.79	71
Overall	0.00	-0.01	2.04	19.25	0.95	53,774	0.58	4.87	3.39	28.44	0.86	3,463

Table S2. Statistical results of the machine learning models for predicting business-as-usual O₃ concentrations for both training and testing datasets. Metrics are Mean Bias (MB), normalized Mean Bias (nMB), Root Mean Square Error (RMSE), normalized Root Mean Square Error (nRMSE), Pearson Correlation Coefficient (PCC), Number of points (N).

City	Training						Testing					
	MB	nMB	RMSE	nRMSE	PCC	N	MB	nMB	RMSE	nRMSE	PCC	N
La Coruña	0.01	0.06	2.45	9.83	0.96	1,089	-1.47	-5.32	4.59	16.56	0.83	71
Albacete	0.00	-0.01	4.04	12.68	0.92	1,005	1.89	9.42	4.76	23.72	0.81	65
Alicante	0.00	0.01	2.90	9.68	0.95	1,094	-0.47	-1.97	4.05	17.08	0.84	72
Almería	-0.04	-0.13	3.24	9.66	0.93	1,082	2.12	8.23	5.50	21.32	0.65	56
Oviedo	0.00	-0.01	1.20	4.94	0.99	1,090	1.77	7.91	4.92	21.97	0.83	73
Badajoz	0.01	0.02	4.38	14.17	0.87	916	1.50	6.90	4.07	18.78	0.80	56
Barcelona	-0.02	-0.06	4.04	16.26	0.89	1,092	1.02	5.21	3.75	19.08	0.88	73
Bilbao	0.00	0.02	3.30	15.29	0.90	983	-2.60	-12.90	5.13	25.41	0.84	59
Burgos	-0.01	-0.02	5.08	16.32	0.80	1,062	1.59	5.90	4.70	17.44	0.81	72
Santander	-0.01	-0.05	3.53	13.16	0.93	1,015	3.16	12.48	5.83	23.04	0.86	73
Castellón	0.01	0.03	3.30	11.17	0.93	1,090	2.20	11.25	4.51	23.07	0.85	72
Ciudad Real	0.00	0.00	3.93	12.37	0.92	1,061	4.22	19.97	5.61	26.53	0.89	63
Cuenca	-0.02	-0.07	4.45	15.54	0.89	1,050	0.14	0.74	3.29	17.62	0.90	59
Cáceres	0.02	0.07	3.66	10.60	0.94	1,019	0.14	0.57	4.02	16.70	0.86	66
Cádiz	-0.01	-0.01	2.92	8.19	0.96	1,013	-1.70	-5.57	4.49	14.71	0.92	36
Córdoba	-0.01	-0.02	3.11	10.33	0.96	1,080	3.91	19.58	5.05	25.31	0.85	56
San Sebastián	-0.01	-0.03	2.15	8.41	0.97	1,081	3.90	18.08	5.97	27.68	0.84	70
Granada	0.00	0.02	3.29	11.87	0.95	998	4.41	33.96	8.98	69.10	0.02	48
Guadalajara	0.01	0.03	3.24	11.08	0.95	1,040	1.79	9.60	4.00	21.41	0.91	62
Huelva	0.01	0.03	3.87	11.53	0.89	1,075	2.13	7.91	5.22	19.41	0.68	55
Huesca	-0.01	-0.03	4.28	13.64	0.93	1,072	2.07	9.88	5.30	25.26	0.84	68
Jaén	0.00	0.01	3.54	9.51	0.95	1,082	2.28	8.39	4.88	17.94	0.82	56
Logroño	-0.01	-0.06	4.39	17.49	0.85	1,044	1.89	11.00	4.55	26.51	0.78	71
León	0.01	0.03	1.78	6.30	0.98	1,040	0.06	0.29	4.11	18.99	0.87	65
Lleida	-0.02	-0.07	4.13	14.70	0.93	1,069	2.38	14.67	5.52	33.98	0.84	71
Lugo	0.02	0.11	3.79	16.76	0.89	1,066	3.56	20.22	8.08	45.83	0.55	65
Madrid	0.00	-0.01	2.03	7.93	0.98	1,089	0.10	0.68	4.03	27.27	0.90	73
Mallorca	0.00	-0.01	2.18	7.01	0.97	1,094	0.44	1.63	4.90	18.24	0.74	73
Murcia	-0.02	-0.09	2.07	8.08	0.98	1,054	0.42	2.98	3.06	21.73	0.88	70
Málaga	0.00	0.00	2.07	6.09	0.97	1,080	-0.47	-1.67	4.02	14.16	0.78	56
Pamplona	0.00	-0.02	1.77	8.28	0.98	1,074	-0.71	-4.93	3.60	24.85	0.86	71
Ourense	-0.02	-0.11	4.31	23.11	0.86	957	0.46	2.91	4.35	27.72	0.81	44
Pontevedra	0.01	0.03	3.32	14.87	0.94	1,073	0.11	0.58	3.70	19.66	0.90	71
Salamanca	0.01	0.02	2.52	8.21	0.97	1,047	0.65	2.89	4.80	21.42	0.83	68
Segovia	0.04	0.13	4.77	14.38	0.88	1,033	0.34	1.34	4.58	17.91	0.71	72
Sevilla	0.02	0.06	4.19	15.29	0.91	1,082	0.69	3.93	4.28	24.34	0.82	56
Soria	-0.02	-0.05	4.00	13.59	0.88	1,076	0.05	0.18	3.44	13.64	0.88	71
Tarragona	0.00	0.01	3.33	11.70	0.94	1,038	0.84	3.53	6.11	25.55	0.71	59
Teruel	0.01	0.04	4.32	13.79	0.91	1,046	-1.71	-7.41	5.45	23.63	0.82	52
Toledo	0.02	0.06	4.92	16.37	0.91	1,013	4.10	23.66	5.57	32.17	0.90	59
Valencia	0.00	0.00	2.87	11.23	0.95	1,083	3.81	24.02	5.15	32.48	0.89	72
Valladolid	-0.02	-0.08	4.05	14.52	0.92	1,080	2.29	12.67	4.08	22.56	0.92	63
Zamora	-0.01	-0.03	4.24	14.07	0.91	1,078	1.40	6.13	5.04	22.01	0.85	72
Zaragoza	-0.01	-0.05	4.00	15.01	0.94	1,094	6.31	46.66	7.38	54.53	0.88	73
Ávila	0.00	0.01	3.26	9.73	0.94	1,070	3.27	13.94	6.18	26.35	0.81	70
Overall	0.00	0.00	3.57	12.17	0.94	59,279	1.35	5.93	5.12	22.43	0.86	3,625

Table S3. Mortality attributable to NO₂ in the main Spanish cities, 2010-2018. Estimates with 95% CI.

City	Attributable number	Attributable fraction (%)
Madrid	4,795 (1,512 to 8,024)	2.0 (0.6 to 3.4)
Barcelona	2,438 (446 to 4,398)	1.8 (0.3 to 3.3)
Valencia	914 (232 to 1,588)	1.4 (0.4 to 2.5)
Sevilla	761 (205 to 1,310)	1.4 (0.4 to 2.4)
Zaragoza	708 (171 to 1,240)	1.3 (0.3 to 2.3)
Málaga	488 (140 to 832)	1.2 (0.3 to 2.0)
Bilbao	486 (115 to 852)	1.5 (0.4 to 2.6)
Murcia	481 (110 to 845)	1.8 (0.4 to 3.2)
Granada	376 (88 to 659)	1.9 (0.4 to 3.3)
Valladolid	290 (71 to 506)	1.1 (0.3 to 2.0)
Córdoba	256 (63 to 447)	1.1 (0.3 to 1.9)
Oviedo	244 (62 to 425)	1.2 (0.3 to 2.2)
Alicante	241 (66 to 414)	1.0 (0.3 to 1.8)
La Coruña	241 (63 to 418)	1.1 (0.3 to 2.0)
Mallorca	234 (53 to 414)	0.9 (0.2 to 1.6)
Vitoria	201 (54 to 347)	1.2 (0.3 to 2.1)
San Sebastián	193 (50 to 336)	1.2 (0.3 to 2.1)
Santander	193 (45 to 340)	1.2 (0.3 to 2.1)
Pamplona	185 (46 to 323)	1.2 (0.3 to 2.1)
León	138 (33 to 243)	1.1 (0.3 to 1.9)
Ourense	123 (30 to 216)	1.2 (0.3 to 2.2)
Almería	117 (27 to 206)	0.9 (0.2 to 1.6)
Lleida	114 (28 to 199)	1.2 (0.3 to 2.0)
Salamanca	112 (27 to 196)	0.8 (0.2 to 1.4)
Castellón	105 (26 to 183)	0.9 (0.2 to 1.5)
Burgos	100 (26 to 173)	0.7 (0.2 to 1.2)
Cádiz	94 (26 to 161)	0.8 (0.2 to 1.4)
Tarragona	93 (23 to 163)	1.1 (0.3 to 1.9)
Girona	92 (23 to 159)	1.5 (0.4 to 2.6)
Huelva	77 (17 to 137)	0.7 (0.2 to 1.3)
Albacete	68 (17 to 120)	0.6 (0.2 to 1.1)
Logroño	68 (16 to 120)	0.6 (0.1 to 1.1)
Jaén	67 (15 to 118)	0.8 (0.2 to 1.4)
Pontevedra	60 (15 to 104)	1.0 (0.3 to 1.7)
Guadalajara	58 (14 to 101)	1.1 (0.3 to 1.9)
Lugo	51 (13 to 90)	0.6 (0.1 to 1.1)
Toledo	51 (13 to 88)	1.0 (0.3 to 1.8)
Huesca	43 (10 to 75)	0.9 (0.2 to 1.6)
Badajoz	41 (10 to 72)	0.4 (0.1 to 0.7)
Cuenca	38 (10 to 67)	0.9 (0.2 to 1.5)
Soria	36 (9 to 63)	1.1 (0.3 to 1.9)
Zamora	36 (9 to 62)	0.6 (0.1 to 1.1)
Cáceres	32 (8 to 56)	0.5 (0.1 to 0.9)
Segovia	30 (8 to 52)	0.6 (0.2 to 1.1)
Ciudad Real	25 (6 to 44)	0.5 (0.1 to 0.9)
Teruel	19 (5 to 33)	0.7 (0.2 to 1.2)
Ávila	18 (5 to 32)	0.4 (0.1 to 0.8)
Total	15,631 (4,061 to 27,051)	1.4 (0.4 to 2.5)

Table S4. Mortality attributable to O₃ in the main Spanish cities, 2010-2018. Estimates with 95% CI.

City	Attributable number	Attributable fraction (%)
Madrid	5,398 (860 to 9,830)	2.3 (0.4 to 4.1)
Barcelona	1,380 (-1,539 to 4,226)	1.0 (-1.1 to 3.1)
Sevilla	1,147 (-139 to 2,396)	2.1 (-0.3 to 4.4)
Valencia	1,040 (-484 to 2,524)	1.6 (-0.8 to 3.9)
Málaga	898 (-363 to 2,118)	2.2 (-0.9 to 5.2)
Zaragoza	683 (-524 to 1,858)	1.2 (-1.0 to 3.4)
Bilbao	598 (-44 to 1,225)	1.8 (-0.1 to 3.7)
Córdoba	597 (-90 to 1,261)	2.5 (-0.4 to 5.3)
Mallorca	553 (-220 to 1,303)	2.1 (-0.8 to 5.0)
Alicante	529 (-140 to 1,177)	2.2 (-0.6 to 5.0)
Valladolid	513 (-131 to 1,138)	2.0 (-0.5 to 4.4)
La Coruña	422 (-61 to 893)	2.0 (-0.3 to 4.2)
Burgos	397 (-19 to 799)	2.7 (-0.1 to 5.5)
Oviedo	349 (-76 to 765)	1.8 (-0.4 to 3.9)
Cádiz	348 (-37 to 720)	3.1 (-0.3 to 6.4)
Salamanca	344 (-58 to 733)	2.5 (-0.4 to 5.3)
Castellón	332 (0 to 654)	2.8 (0.0 to 5.5)
San Sebastián	329 (-43 to 692)	2.0 (-0.3 to 4.2)
Pamplona	313 (-49 to 665)	2.0 (-0.3 to 4.3)
Huelva	279 (-59 to 606)	2.6 (-0.6 to 5.7)
Almería	270 (-154 to 680)	2.1 (-1.2 to 5.2)
Murcia	265 (-385 to 896)	1.0 (-1.4 to 3.3)
Santander	261 (-169 to 679)	1.6 (-1.0 to 4.1)
León	259 (-79 to 588)	2.0 (-0.6 to 4.6)
Granada	257 (-249 to 748)	1.3 (-1.2 to 3.7)
Albacete	236 (-105 to 565)	2.2 (-1.0 to 5.3)
Badajoz	192 (-72 to 449)	2.0 (-0.7 to 4.6)
Tarragona	189 (-41 to 412)	2.2 (-0.5 to 4.7)
Logroño	186 (-74 to 439)	1.6 (-0.7 to 3.9)
Jaén	178 (-114 to 459)	2.2 (-1.4 to 5.6)
Lleida	177 (-54 to 400)	1.8 (-0.5 to 4.1)
Lugo	173 (-32 to 371)	2.0 (-0.4 to 4.4)
Cáceres	169 (-23 to 355)	2.6 (-0.4 to 5.5)
Ourense	147 (-27 to 317)	1.5 (-0.3 to 3.2)
Zamora	131 (-34 to 291)	2.2 (-0.6 to 4.9)
Ciudad Real	117 (-40 to 268)	2.3 (-0.8 to 5.3)
Segovia	115 (-30 to 255)	2.5 (-0.7 to 5.5)
Toledo	109 (-27 to 241)	2.2 (-0.6 to 4.9)
Pontevedra	108 (-25 to 238)	1.8 (-0.4 to 3.9)
Cuenca	105 (-28 to 234)	2.4 (-0.6 to 5.3)
Huesca	103 (-42 to 243)	2.2 (-0.9 to 5.2)
Guadalajara	99 (-56 to 248)	1.8 (-1.0 to 4.6)
Ávila	94 (-36 to 221)	2.3 (-0.9 to 5.3)
Soria	80 (-18 to 174)	2.4 (-0.5 to 5.2)
Teruel	64 (-25 to 150)	2.3 (-0.9 to 5.3)
Total	20,533 (-5,155 to 45,504)	1.9 (-0.5 to 4.2)

Table S5. NO₂ levels during the lockdown and deconfinement periods in Spain

Period	Date	N days	NO ₂ levels (µg/m ³)		
			Observed	Business-as-usual	Difference
Lockdown	Mar 15 to Mar 29	15	11.2	19.6	-8.4
Lockdown (only essential activities)	Mar 30 to Apr 12	14	9.2	21.0	-11.8
Lockdown	Apr 13 to May 10	28	8.6	18.0	-9.4
Deconfinement	May 11 to Jun 21	42	10.5	16.5	-6.0
Overall	Mar 15 to Jun 21	99	9.9	18.0	-8.1

Table S6. Reduction in NO₂ and mortality attributable to NO₂ during the lockdown and deconfinement in the main Spanish cities.

¹Average of the period 2010-2018; ²OBS = Observed; ³BAU = Business-as-usual; ⁴DIF (%) = Difference [(OBS-BAU)/BAU*100%]; BAU 2 = Estimates without considering the uncertainty in BAU levels; DIF 2 = without considering the uncertainty in BAU levels. Estimates with 95% CI.

City	N deaths ¹	NO ₂ levels (µg/m ³)			Attributable mortality				
		OBS ²	BAU ³	DIF ⁴ (%)	OBS	BAU	BAU 2	DIF	DIF 2
Albacete	311	6.6	9.9	-33.5	0 (0 to 1)	1 (0 to 3)	1 (0 to 3)	-1 (-2 to 0)	-1 (-2 to 0)
Alicante	671	7.1	14.6	-51.4	2 (0 to 5)	5 (0 to 11)	5 (1 to 8)	-3 (-6 to 0)	-3 (-3 to -1)
Almería	371	9.4	17.9	-47.6	1 (0 to 2)	3 (0 to 6)	3 (0 to 6)	-2 (-4 to 0)	-2 (-4 to 0)
Badajoz	286	4.1	6.8	-39.4	0 (0 to 0)	0 (0 to 2)	0 (0 to 1)	0 (-2 to 0)	0 (-1 to 0)
Barcelona	3,881	16.8	33.7	-50.1	29 (5 to 53)	57 (10 to 115)	57 (11 to 104)	-28 (-62 to -5)	-28 (-51 to -6)
Bilbao	954	16.3	22.1	-26.2	8 (1 to 13)	11 (2 to 20)	11 (2 to 17)	-3 (-7 to -1)	-3 (-4 to -1)
Burgos	416	8	13.1	-38.4	1 (0 to 3)	2 (0 to 6)	2 (0 to 5)	-1 (-3 to 0)	-1 (-2 to 0)
Cáceres	183	2.5	5.1	-50.7	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
Cádiz	335	5	10	-49.8	0 (0 to 0)	0 (0 to 3)	0 (0 to 3)	0 (-3 to 0)	0 (-3 to 0)
Castellón	350	10	15.4	-35.1	1 (0 to 2)	3 (0 to 5)	3 (0 to 5)	-2 (-3 to 0)	-2 (-3 to 0)
Ciudad Real	147	8.8	14.7	-40.1	0 (0 to 1)	0 (0 to 2)	0 (0 to 2)	0 (-1 to 0)	0 (-1 to 0)
Córdoba	679	5.8	11.7	-50.4	1 (0 to 4)	4 (0 to 8)	4 (0 to 6)	-3 (-4 to 0)	-3 (-2 to 0)
Cuenca	121	13.7	29.9	-54.2	0 (0 to 1)	1 (0 to 3)	1 (0 to 3)	-1 (-2 to 0)	-1 (-2 to 0)
Girona	169	10.6	21.5	-50.9	0 (0 to 1)	2 (0 to 4)	2 (0 to 3)	-2 (-3 to 0)	-2 (-2 to 0)
Granada	596	17.5	31	-43.5	5 (0 to 9)	9 (2 to 17)	9 (2 to 16)	-4 (-8 to -2)	-4 (-7 to -2)
Guadalajara	168	8.8	19.1	-54.3	0 (0 to 1)	1 (0 to 3)	1 (0 to 3)	-1 (-2 to 0)	-1 (-2 to 0)
Huelva	314	9.1	15.5	-41.6	1 (0 to 2)	2 (0 to 5)	2 (0 to 4)	-1 (-3 to 0)	-1 (-2 to 0)
Huesca	137	7.4	16.8	-56	0 (0 to 0)	0 (0 to 2)	0 (0 to 2)	0 (-2 to 0)	0 (-2 to 0)
Jaén	244	5.6	11.2	-50.2	0 (0 to 1)	0 (0 to 3)	0 (0 to 2)	0 (-2 to 0)	0 (-1 to 0)
La Coruña	617	8.4	18	-53.4	3 (0 to 5)	5 (0 to 11)	5 (0 to 10)	-2 (-6 to 0)	-2 (-5 to 0)
León	379	9.5	16.6	-42.4	1 (0 to 4)	4 (0 to 6)	4 (0 to 5)	-3 (-2 to 0)	-3 (-1 to 0)
Lleida	278	9.8	18.5	-47	1 (0 to 2)	2 (0 to 5)	2 (0 to 5)	-1 (-3 to 0)	-1 (-3 to 0)
Logroño	327	7.9	12	-34.3	1 (0 to 2)	2 (0 to 4)	2 (0 to 4)	-1 (-2 to 0)	-1 (-2 to 0)
Lugo	247	5.5	12.3	-55.4	0 (0 to 0)	0 (0 to 4)	0 (0 to 3)	0 (-4 to 0)	0 (-3 to 0)
Madrid	6,965	13.6	29.1	-53.3	49 (15 to 82)	106 (31 to 200)	106 (33 to 178)	-57 (-118 to -16)	-57 (-96 to -18)
Málaga	1,165	12.6	22.6	-44.2	8 (2 to 12)	13 (4 to 26)	13 (4 to 23)	-5 (-14 to -2)	-5 (-11 to -2)
Mallorca	773	7.9	19.7	-59.6	3 (0 to 5)	7 (1 to 14)	7 (1 to 12)	-4 (-9 to -1)	-4 (-7 to -1)
Murcia	755	23.3	30.8	-24.4	8 (2 to 15)	11 (2 to 21)	11 (2 to 19)	-3 (-6 to 0)	-3 (-4 to 0)
Ourense	290	11.2	21.6	-48.1	1 (0 to 3)	4 (0 to 6)	4 (0 to 6)	-3 (-3 to 0)	-3 (-3 to 0)
Oviedo	567	13.6	20.7	-34.2	4 (0 to 7)	6 (0 to 11)	6 (1 to 11)	-2 (-4 to 0)	-2 (-4 to -1)
Pamplona	449	11	21.4	-48.4	3 (0 to 5)	5 (0 to 10)	5 (0 to 8)	-2 (-5 to 0)	-2 (-3 to 0)
Pontevedra	185	8.7	14.3	-39.1	0 (0 to 1)	0 (0 to 4)	0 (0 to 2)	0 (-3 to 0)	0 (-1 to 0)
Salamanca	404	6.3	10.4	-38.8	0 (0 to 1)	2 (0 to 5)	2 (0 to 4)	-2 (-4 to 0)	-2 (-3 to 0)
San Sebastián	475	11.9	20.3	-41.5	3 (0 to 5)	5 (0 to 10)	5 (0 to 8)	-2 (-5 to 0)	-2 (-3 to 0)
Santander	484	11.1	20.2	-44.9	2 (0 to 5)	5 (0 to 10)	5 (0 to 8)	-3 (-5 to 0)	-3 (-3 to 0)
Segovia	134	6.5	10.8	-40.4	0 (0 to 0)	0 (0 to 1)	0 (0 to 0)	0 (-1 to 0)	0 (0 to 0)
Sevilla	1,554	11	20.8	-47.2	9 (2 to 14)	16 (4 to 31)	16 (5 to 28)	-7 (-17 to -2)	-7 (-14 to -3)
Soria	97	9.4	18.6	-49.7	0 (0 to 0)	0 (0 to 2)	0 (0 to 1)	0 (-2 to 0)	0 (-1 to 0)
Tarragona	247	10.7	18.1	-40.8	1 (0 to 2)	2 (0 to 4)	2 (0 to 4)	-1 (-2 to 0)	-1 (-2 to 0)
Teruel	93	6.2	10.4	-40.4	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
Toledo	142	7.2	15.8	-54.5	0 (0 to 0)	0 (0 to 2)	0 (0 to 2)	0 (-2 to 0)	0 (-2 to 0)
Valencia	1,828	10.1	20.8	-51.5	8 (2 to 15)	18 (4 to 39)	18 (5 to 31)	-10 (-24 to -2)	-10 (-16 to -3)
Valladolid	756	9.4	17.4	-45.6	3 (0 to 6)	6 (1 to 12)	6 (1 to 11)	-3 (-6 to -1)	-3 (-5 to -1)
Vitoria	476	5.9	8.9	-34.3	1 (0 to 2)	2 (0 to 5)	2 (0 to 4)	-1 (-3 to 0)	-1 (-2 to 0)
Zamora	168	7.3	11.7	-37	0 (0 to 0)	0 (0 to 2)	0 (0 to 1)	0 (-2 to 0)	0 (-1 to 0)
Zaragoza	1,562	12.2	22.5	-45.6	9 (2 to 17)	17 (4 to 33)	17 (4 to 29)	-8 (-16 to -2)	-8 (-12 to -2)
Total	31,750	9.9	18.0	-45.0	167 (31 to 309)	339 (65 to 696)	339 (72 to 610)	-172 (-387 to -34)	-172 (-301 to -41)

Table S7. Mortality attributable to NO₂ during the lockdown and deconfinement in Spain. ¹OBS = Observed; ²BAU = Business-as-usual; ³DIF = Difference (OBS-BAU); %]; BAU 2 = Estimates without considering the uncertainty in BAU levels; DIF 2 = without considering the uncertainty in BAU levels. Estimates with 95% empirical CI.

Period	Date	N days	Number of deaths attributable to NO ₂				
			¹ OBS	² BAU	BAU 2	³ DIF	DIF 2
Lockdown	Mar 15 to Mar 29	15	33 (4 to 56)	57 (10 to 122)	57 (12 to 107)	-24 (-66 to -6)	-24 (-51 to -8)
Lockdown (only essential activities)	Mar 30 to Apr 12	14	21 (3 to 43)	59 (12 to 132)	59 (12 to 107)	-38 (-89 to -9)	-38 (-64 to -9)
Lockdown	Apr 13 to May 10	28	39 (10 to 77)	96 (19 to 195)	96 (19 to 172)	-57 (-118 to -9)	-57 (-95 to -9)
Deconfinement	May 11 to Jun 21	42	74 (14 to 133)	127 (24 to 247)	127 (29 to 224)	-53 (-114 to -10)	-53 (-91 to -15)
Overall	Mar 15 to Jun 21	99	167 (31 to 309)	339 (65 to 696)	339 (72 to 610)	-172 (-387 to -34)	-172 (-301 to -41)

Table S8. Reduction in O₃ and mortality attributable to O₃ during the lockdown and deconfinement in the main Spanish cities.

¹Average of the period 2010-2018; ²OBS = Observed; ³BAU = Business-as-usual; ⁴DIF (%) = Difference [(OBS-BAU)/BAU*100%]; BAU 2 = Estimates without considering the uncertainty in BAU levels; DIF 2 = without considering the uncertainty in BAU levels. Estimates with 95% CI.

City	N deaths ¹	O3 levels (µg/m3)			Attributable mortality				
		OBS2	BAU3	DIF4 (%)	OBS	BAU	BAU 2	DIF	DIF 2
Albacete	311	64.3	62.3	3.2	7 (-3 to 17)	7 (-2 to 17)	7 (-3 to 16)	0 (-1 to 3)	0 (0 to 1)
Alicante	671	72.6	69.5	4.4	19 (-5 to 42)	18 (-5 to 43)	18 (-5 to 40)	1 (-2 to 3)	1 (0 to 2)
Almería	371	75	68.4	9.6	9 (-5 to 23)	8 (-5 to 22)	8 (-5 to 22)	1 (0 to 4)	1 (0 to 1)
Ávila	123	65.7	71.5	-8.1	3 (0 to 7)	3 (0 to 7)	3 (-1 to 7)	0 (0 to 0)	0 (0 to 1)
Badajoz	286	55.4	60.1	-7.9	7 (-2 to 14)	7 (-2 to 15)	7 (-2 to 14)	0 (-1 to 0)	0 (0 to 0)
Barcelona	3881	63.3	56.1	12.8	51 (-58 to 160)	46 (-48 to 152)	46 (-52 to 142)	5 (-3 to 27)	5 (-6 to 18)
Bilbao	954	56.6	47.3	19.8	25 (-2 to 49)	20 (-1 to 46)	20 (-1 to 41)	5 (-1 to 12)	5 (-1 to 8)
Burgos	416	65.2	64.9	0.4	14 (0 to 26)	14 (0 to 28)	14 (0 to 26)	0 (-3 to 2)	0 (-1 to 1)
Cáceres	183	64.3	67.3	-4.6	5 (0 to 11)	5 (0 to 12)	5 (0 to 12)	0 (-1 to 0)	0 (-1 to 0)
Cádiz	335	77.3	67.1	15.1	11 (0 to 23)	10 (0 to 22)	10 (0 to 21)	1 (0 to 6)	1 (0 to 2)
Castellón	350	61	64.5	-5.4	12 (0 to 22)	12 (0 to 22)	12 (0 to 22)	0 (-1 to 1)	0 (-1 to 1)
Ciudad Real	147	65.1	70.8	-8	4 (-1 to 8)	4 (-1 to 9)	4 (-1 to 8)	0 (-1 to 0)	0 (0 to 0)
Córdoba	679	65.6	71.7	-8.5	19 (-2 to 40)	21 (-2 to 47)	21 (-3 to 44)	-2 (-7 to 0)	-2 (-4 to 1)
Cuenca	121	61.3	57.8	6.1	2 (0 to 7)	2 (0 to 7)	2 (0 to 6)	0 (0 to 1)	0 (0 to 1)
Granada	596	55.2	62.4	-11.6	8 (-7 to 22)	10 (-8 to 30)	10 (-9 to 27)	-2 (-8 to 1)	-2 (-5 to 2)
Guadalajara	168	64.3	65.3	-1.5	3 (-2 to 8)	3 (-2 to 10)	3 (-2 to 8)	0 (-2 to 0)	0 (0 to 0)
Huelva	314	69.9	74.1	-5.6	8 (-2 to 19)	10 (-2 to 22)	10 (-2 to 21)	-2 (-3 to 0)	-2 (-2 to 0)
Huesca	137	65.5	67	-2.3	3 (-1 to 7)	3 (-1 to 7)	3 (-1 to 7)	0 (0 to 0)	0 (0 to 0)
Jaén	244	79.1	79.7	-0.7	7 (-4 to 15)	7 (-4 to 16)	7 (-4 to 15)	0 (-1 to 0)	0 (0 to 0)
La Coruña	617	62.1	59.4	4.5	16 (-2 to 34)	16 (-2 to 35)	16 (-2 to 33)	0 (-1 to 3)	0 (0 to 1)
León	379	60.3	59.6	1.2	8 (-2 to 20)	8 (-2 to 20)	8 (-2 to 20)	0 (0 to 2)	0 (0 to 0)
Lleida	278	55.6	60.7	-8.3	7 (-1 to 14)	7 (-2 to 16)	7 (-2 to 14)	0 (-2 to 1)	0 (0 to 1)
Logroño	327	57.1	55.3	3.3	7 (-2 to 16)	7 (-2 to 16)	7 (-2 to 15)	0 (0 to 2)	0 (0 to 1)
Lugo	247	47.5	52	-8.6	6 (0 to 12)	6 (0 to 13)	6 (0 to 12)	0 (-1 to 1)	0 (0 to 0)
Madrid	6965	62.9	58.2	8	209 (34 to 379)	194 (30 to 375)	194 (31 to 352)	15 (0 to 45)	15 (3 to 27)
Málaga	1165	76.7	74.3	3.2	31 (-12 to 71)	29 (-11 to 73)	29 (-12 to 69)	2 (-3 to 5)	2 (-1 to 3)
Mallorca	773	73.7	71.5	3.2	19 (-7 to 47)	19 (-7 to 49)	19 (-7 to 46)	0 (-3 to 3)	0 (-1 to 2)
Murcia	755	54.1	49.6	9.2	8 (-12 to 28)	8 (-11 to 28)	8 (-11 to 26)	0 (-2 to 4)	0 (-2 to 3)
Ourense	290	42.8	43.9	-2.6	6 (0 to 11)	6 (0 to 13)	6 (0 to 12)	0 (-2 to 1)	0 (-1 to 0)
Oviedo	567	58.1	52.5	10.7	14 (-2 to 28)	12 (-2 to 28)	12 (-2 to 26)	2 (-1 to 4)	2 (0 to 2)
Pamplona	449	49.5	47	5.3	9 (-1 to 20)	9 (-1 to 21)	9 (-1 to 18)	0 (-1 to 2)	0 (0 to 2)
Pontevedra	185	43.9	49.8	-11.9	3 (0 to 7)	4 (0 to 9)	4 (0 to 8)	-1 (-2 to 0)	-1 (-1 to 0)
Salamanca	404	60.8	65.6	-7.3	11 (-1 to 22)	11 (-1 to 25)	11 (-2 to 24)	0 (-3 to 0)	0 (-2 to 1)
San Sebastián	475	59.3	62.7	-5.5	13 (-1 to 26)	13 (-1 to 29)	13 (-2 to 26)	0 (-3 to 1)	0 (-1 to 2)
Santander	484	69.6	69.7	-0.2	10 (-7 to 25)	10 (-6 to 29)	10 (-7 to 26)	0 (-4 to 0)	0 (-1 to 0)
Segovia	134	66.8	70.2	-4.8	5 (0 to 7)	5 (0 to 9)	5 (0 to 7)	0 (-2 to 0)	0 (0 to 0)
Sevilla	1554	63	60.4	4.4	42 (-5 to 86)	39 (-5 to 88)	39 (-5 to 83)	3 (-2 to 7)	3 (0 to 3)
Soria	97	67.5	62.2	8.6	2 (0 to 6)	2 (0 to 6)	2 (0 to 6)	0 (0 to 0)	0 (0 to 0)
Tarragona	247	64.9	70.8	-8.3	7 (-1 to 14)	7 (-1 to 17)	7 (-1 to 14)	0 (-3 to 0)	0 (0 to 0)
Teruel	93	65.7	63.4	3.7	2 (0 to 5)	2 (0 to 5)	2 (0 to 5)	0 (0 to 0)	0 (0 to 0)
Toledo	142	72.3	66.5	8.7	4 (-1 to 8)	4 (0 to 9)	4 (0 to 8)	0 (-2 to 0)	0 (-1 to 0)
Valencia	1828	62.4	61.7	1.1	38 (-19 to 93)	39 (-17 to 99)	39 (-18 to 92)	-1 (-6 to 6)	-1 (-3 to 3)
Valladolid	756	55.1	59.8	-7.9	15 (-5 to 35)	18 (-5 to 42)	18 (-5 to 38)	-3 (-7 to 0)	-3 (-3 to 0)
Zamora	168	61.4	68.3	-10.1	5 (0 to 9)	5 (0 to 11)	5 (-1 to 9)	0 (-2 to 0)	0 (0 to 1)
Zaragoza	1562	52.8	59.4	-11.1	22 (-16 to 60)	24 (-17 to 72)	24 (-19 to 67)	-2 (-12 to 2)	-2 (-7 to 3)
Total	31,228	62.4	62.7	-0.5	736 (-157 to 1603)	714 (-146 to 1671)	714 (-161 to 1555)	22 (-99 to 149)	22 (-42 to 94)

Table S9. O₃ levels during the lockdown and deconfinement periods in Spain

Period	Date	N days	O ₃ levels (µg/m ³)		
			Observed	Business-as-usual	Difference
Lockdown	Mar 15 to Mar 29	15	60.6	62.3	-1.7
Lockdown (only essential activities)	Mar 30 to Apr 12	14	62.8	59.4	3.4
Lockdown	Apr 13 to May 10	28	60.3	62.5	-2.2
Deconfinement	May 11 to Jun 21	42	64.4	64.0	0.4
Overall	Mar 15 to Jun 21	99	62.4	62.7	-0.3

Table S10. Mortality attributable to O₃ during the lockdown and deconfinement in Spain. ¹OBS = Observed; ²BAU = Business-as-usual; ³DIF = Difference (OBS-BAU); %]; BAU 2 = Estimates without considering the uncertainty in BAU levels; DIF 2 = without considering the uncertainty in BAU levels. Estimates with 95% empirical CI.

Period	Date	N days	Number of deaths attributable to O ₃				
			¹ OBS	² BAU	BAU 2	³ DIF	DIF 2
Lockdown	Mar 15 to Mar 29	15	117 (-22 to 253)	115 (-21 to 278)	115 (-25 to 249)	2 (-28 to 26)	2 (-11 to 18)
Lockdown (only essential activities)	Mar 30 to Apr 12	14	106 (-20 to 237)	96 (-16 to 235)	96 (-19 to 216)	10 (-9 to 41)	10 (-5 to 25)
Lockdown	Apr 13 to May 10	28	203 (-43 to 435)	201 (-43 to 465)	201 (-46 to 434)	2 (-35 to 32)	2 (-14 to 18)
Deconfinement	May 11 to Jun 21	42	310 (-72 to 678)	302 (-66 to 693)	302 (-71 to 656)	8 (-27 to 50)	8 (-12 to 33)
Overall	Mar 15 to Jun 21	99	736 (-157 to 1603)	714 (-147 to 1671)	714 (-161 to 1555)	22 (-99 to 149)	22 (-42 to 94)