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## Supplemental Material

### **Desert Dust Outbreaks in Southern Europe: Contribution to Daily PM<sub>10</sub> Concentrations and Short-Term Associations with Mortality and Hospital Admissions**

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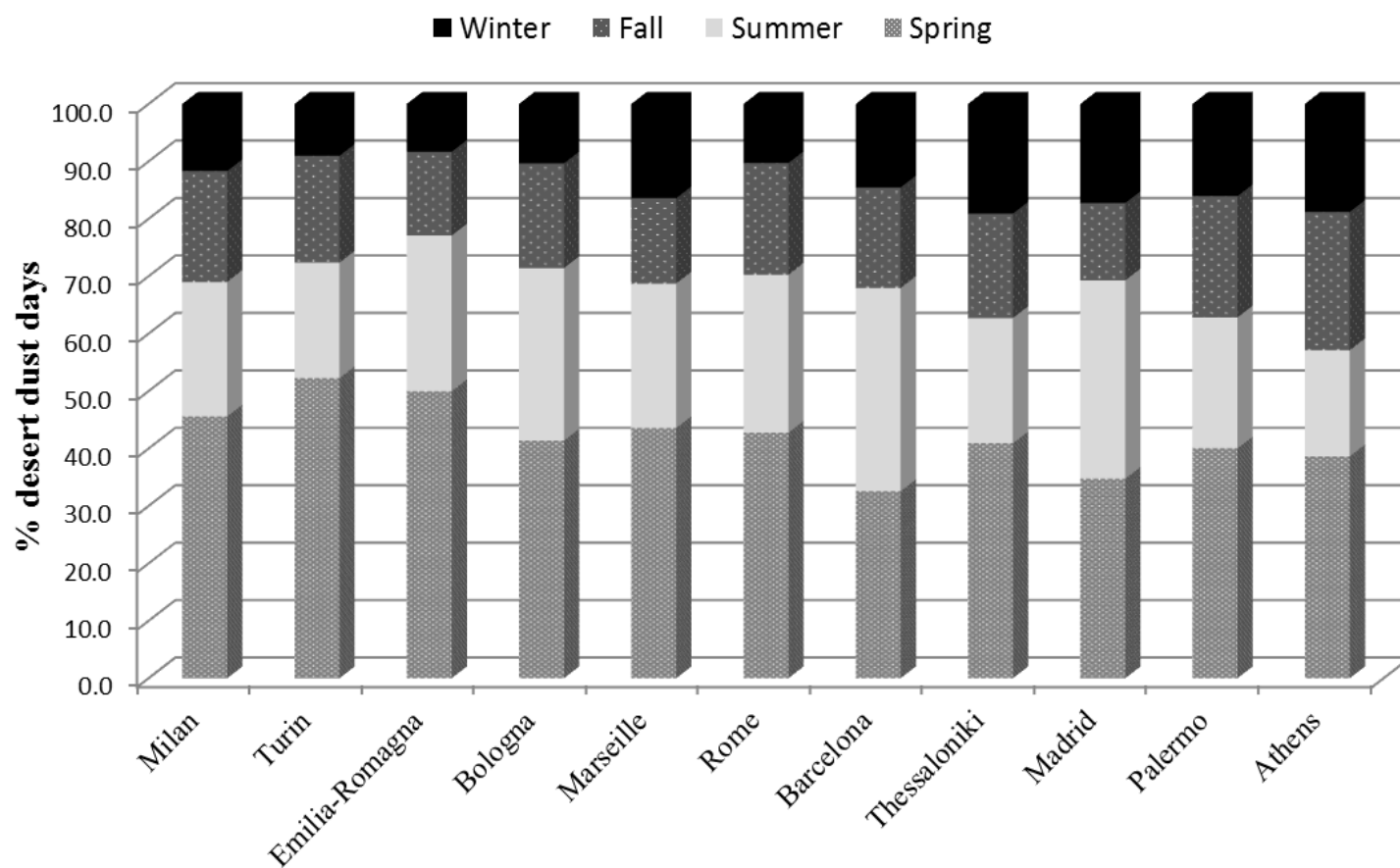
correlations on days without desert dust. The cities are ordered by latitude, North to South. PM and ozone are measured as  $\mu\text{g}/\text{m}^3$ , air temperature as  $^{\circ}\text{C}$  (continued)

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**Table S1.** Daily PM concentrations (mean  $\pm$  SD,  $\mu\text{g}/\text{m}^3$ ) by desert dust advection, in the eleven cities of the MED-PARTICLES project

City <sup>a</sup>	Study period	Days with no desert dust <sup>b</sup>			Days with desert dust <sup>b</sup>				
		PM <sub>10</sub>	PM <sub>2.5</sub>	PM <sub>2.5-10</sub>	PM <sub>10</sub>	Non-desert PM <sub>10</sub>	Desert PM <sub>10</sub>	PM <sub>2.5</sub>	PM <sub>2.5-10</sub>
Milan	2007-2010	44.7 $\pm$ 31.5	31.4 $\pm$ 26.3	14.2 $\pm$ 9.6	45.1 $\pm$ 23.9	28.2 $\pm$ 16.9	16.9 $\pm$ 15.1	28.2 $\pm$ 19.1	16.3 $\pm$ 8.8
Turin	2006-2010	48.5 $\pm$ 37.1	34.8 $\pm$ 28.9	-	47.0 $\pm$ 29.7	30.9 $\pm$ 20.4	16.0 $\pm$ 15.9	32.6 $\pm$ 23.3	-
Emilia-Romagna <sup>c</sup>	2008-2010	33.9 $\pm$ 19.4	21.6 $\pm$ 15.2	12.1 $\pm$ 6.3	38.1 $\pm$ 18.0	29.0 $\pm$ 16.0	9.0 $\pm$ 8.8	21.0 $\pm$ 11.7	17.0 $\pm$ 8.3
Bologna	2006-2010	38.0 $\pm$ 21.7	25.8 $\pm$ 18.9	-	42.9 $\pm$ 21.8	32.3 $\pm$ 21.4	10.3 $\pm$ 9.7	27.1 $\pm$ 16.7	-
Marseille	2006-2008	24.1 $\pm$ 9.3	15.8 $\pm$ 9.5	7.5 $\pm$ 5.9	33.1 $\pm$ 12.8	20.5 $\pm$ 10.9	12.5 $\pm$ 10.7	19.1 $\pm$ 8.3	11.9 $\pm$ 8.8
Rome	2005-2010	33.7 $\pm$ 14.0	19.5 $\pm$ 10.4	12.2 $\pm$ 5.9	39.7 $\pm$ 13.5	28.5 $\pm$ 10.3	11.2 $\pm$ 10.1	20.0 $\pm$ 7.7	17.9 $\pm$ 8.9
Barcelona	2003-2010	34.4 $\pm$ 15.4	22.4 $\pm$ 10.6	12.0 $\pm$ 9.3	48.0 $\pm$ 18.8	35.3 $\pm$ 17.8	12.9 $\pm$ 11.9	31.2 $\pm$ 13.1	17.0 $\pm$ 12.4
Thessaloniki	2007-2009	46.6 $\pm$ 19.7	28.4 $\pm$ 11.2	17.5 $\pm$ 10.0	53.9 $\pm$ 16.4	42.1 $\pm$ 13.7	11.8 $\pm$ 11.3	33.8 $\pm$ 9.6	20.1 $\pm$ 8.4
Madrid	2001-2009	32.4 $\pm$ 17.8	15.9 $\pm$ 8.8	15.9 $\pm$ 10.7	52.1 $\pm$ 21.7	33.6 $\pm$ 20.0	19.0 $\pm$ 18.4	24.8 $\pm$ 11.8	25.7 $\pm$ 15.4
Palermo	2006-2009	30.5 $\pm$ 9.9	-	-	47.0 $\pm$ 23.0	30.5 $\pm$ 10.6	16.5 $\pm$ 21.3	-	-
Athens	2007-2009	32.3 $\pm$ 12.3	20.7 $\pm$ 8.5	11.4 $\pm$ 7.2	54.0 $\pm$ 28.8	34.0 $\pm$ 7.9	20.0 $\pm$ 26.3	29.0 $\pm$ 12.4	24.8 $\pm$ 23.2

<sup>a</sup> Ordered by latitude, North to South

<sup>b</sup> Desert dust days are defined as days with desert dust advection and estimated PM<sub>10</sub> concentrations at ground level  $> 0 \mu\text{g}/\text{m}^3$

<sup>c</sup> Emilia Romagna includes the cities of Parma, Reggio Emilia, and Modena

**Table S2.** City-specific Pearson correlation coefficients between environmental variables. The lower triangle includes the correlations on days with desert dust. The upper triangle includes the correlations on days without desert dust. The cities are ordered by latitude, North to South. PM and ozone are measured as  $\mu\text{g}/\text{m}^3$ , air temperature as  $^{\circ}\text{C}$

Milan	Non-desert PM <sub>10</sub>	Desert PM <sub>10</sub>	PM <sub>2.5</sub>	PM <sub>2.5-10</sub>	Ozone	Air temperature
Non-desert PM <sub>10</sub>		-	0.96	0.68	-0.50	-0.52
Desert PM <sub>10</sub>	0.11		-	-	-	-
PM <sub>2.5</sub>	0.62	0.77		0.45	-0.55	-0.58
PM <sub>2.5-10</sub>	0.59	0.31	0.25		-0.12	-0.13
Ozone	-0.34	-0.43	-0.63	-0.01		0.87
Air temperature	-0.35	-0.40	-0.64	0.03	0.86	
Turin						
Non-desert PM <sub>10</sub>		-	0.94	-	-0.56	-0.55
Desert PM <sub>10</sub>	0.28		-	-	-	-
PM <sub>2.5</sub>	0.69	0.75		-	-0.60	-0.59
PM <sub>2.5-10</sub>	-	-	-		-	-
Ozone	-0.50	-0.26	-0.56	-		0.84
Air temperature	-0.45	-0.32	-0.58	-	0.79	
Emilia Romagna						
Non-desert PM <sub>10</sub>		-	0.96	0.73	-0.45	-0.44
Desert PM <sub>10</sub>	-0.04		-	-	-	-
PM <sub>2.5</sub>	0.88	0.31		0.52	-0.49	-0.53
PM <sub>2.5-10</sub>	0.65	0.58	0.63		-0.16	-0.06
Ozone	-0.41	0.07	-0.43	-0.10		0.88
Air temperature	-0.42	0.16	-0.44	0.00	0.83	
Bologna						
Non-desert PM <sub>10</sub>		-	0.96	-	-0.50	-0.50
Desert PM <sub>10</sub>	-0.19		-	-	-	-
PM <sub>2.5</sub>	0.90	0.13		-	-0.48	-0.49
PM <sub>2.5-10</sub>	-	-	-		-	-
Ozone	-0.55	0.08	-0.49	-		0.84
Air temperature	-0.58	0.27	-0.55	-	0.77	

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Marseille	Non-desert PM <sub>10</sub>	Desert PM <sub>10</sub>	PM <sub>2.5</sub>	PM <sub>2.5-10</sub>	Ozone	Air temperature
Non-desert PM <sub>10</sub>		-	0.80	0.25	-0.10	-0.08
Desert PM <sub>10</sub>	-0.29		-	-	-	-
PM <sub>2.5</sub>	0.42	0.51		-0.38	-0.33	-0.37
PM <sub>2.5-10</sub>	0.53	0.44	0.07		0.30	0.48
Ozone	0.11	-0.13	-0.07	0.12		0.73
Air temperature	0.25	0.00	-0.18	0.52	0.59	
Rome						
Non-desert PM <sub>10</sub>		-	0.91	0.69	-0.32	-0.21
Desert PM <sub>10</sub>	-0.12		-	-	-	-
PM <sub>2.5</sub>	0.63	0.40		0.36	-0.39	-0.31
PM <sub>2.5-10</sub>	0.44	0.67	0.33		-0.01	0.14
Ozone	-0.15	-0.02	-0.17	-0.02		0.75
Air temperature	-0.04	0.17	0.00	0.18	0.65	
Barcelona						
Non-desert PM <sub>10</sub>		-	0.80	0.73	-0.15	0.02
Desert PM <sub>10</sub>	-0.25		-	-	-	-
PM <sub>2.5</sub>	0.50	0.45		0.19	-0.22	-0.14
PM <sub>2.5-10</sub>	0.67	0.13	0.09		0.01	0.19
Ozone	-0.13	-0.08	-0.24	-0.04		0.59
Air temperature	-0.18	0.02	-0.30	0.06	0.49	
Thessaloniki						
Non-desert PM <sub>10</sub>		-	0.95	0.92	-0.33	-0.17
Desert PM <sub>10</sub>	-0.15		-	-	-	-
PM <sub>2.5</sub>	0.61	0.61		0.77	-0.21	-0.07
PM <sub>2.5-10</sub>	0.74	0.40	0.67		-0.35	-0.23
Ozone	-0.55	0.12	-0.27	-0.45		0.63
Air temperature	-0.30	0.21	-0.04	-0.16	0.70	

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Madrid	Non-desert PM <sub>10</sub>	Desert PM <sub>10</sub>	PM <sub>2.5</sub>	PM <sub>2.5-10</sub>	Ozone	Air temperature
Non-desert PM <sub>10</sub>		-	0.90	0.94	-0.35	0.03
Desert PM <sub>10</sub>	-0.36		-	-	-	-
PM <sub>2.5</sub>	0.45	0.51		0.70	-0.42	0.04
PM <sub>2.5-10</sub>	0.53	0.52	0.68		-0.39	-0.05
Ozone	-0.34	-0.06	-0.23	-0.28		0.65
Air temperature	-0.12	0.09	0.11	-0.03	0.70	
Palermo						
Non-desert PM <sub>10</sub>		-	-	-	-0.29	0.04
Desert PM <sub>10</sub>	-0.08		-	-	-	-
PM <sub>2.5</sub>	-	-		-	-	-
PM <sub>2.5-10</sub>	-	-	-		-	-
Ozone	-0.21	-0.15	-	-		0.35
Air temperature	-0.07	0.13	-	-	0.17	
Athens						
Non-desert PM <sub>10</sub>		-	0.72	0.69	0.06	0.17
Desert PM <sub>10</sub>	0.18		-	-	-	-
PM <sub>2.5</sub>	0.62	0.50		0.22	0.31	0.34
PM <sub>2.5-10</sub>	0.22	0.93	0.25		-0.17	-0.06
Ozone	0.14	-0.18	0.28	-0.29		0.79
Air temperature	0.24	-0.01	0.39	-0.13	0.72	

**Table S3.** Daily mean counts of cause-specific mortality and hospital admissions in the eleven cities of the MED-PARTICLES project

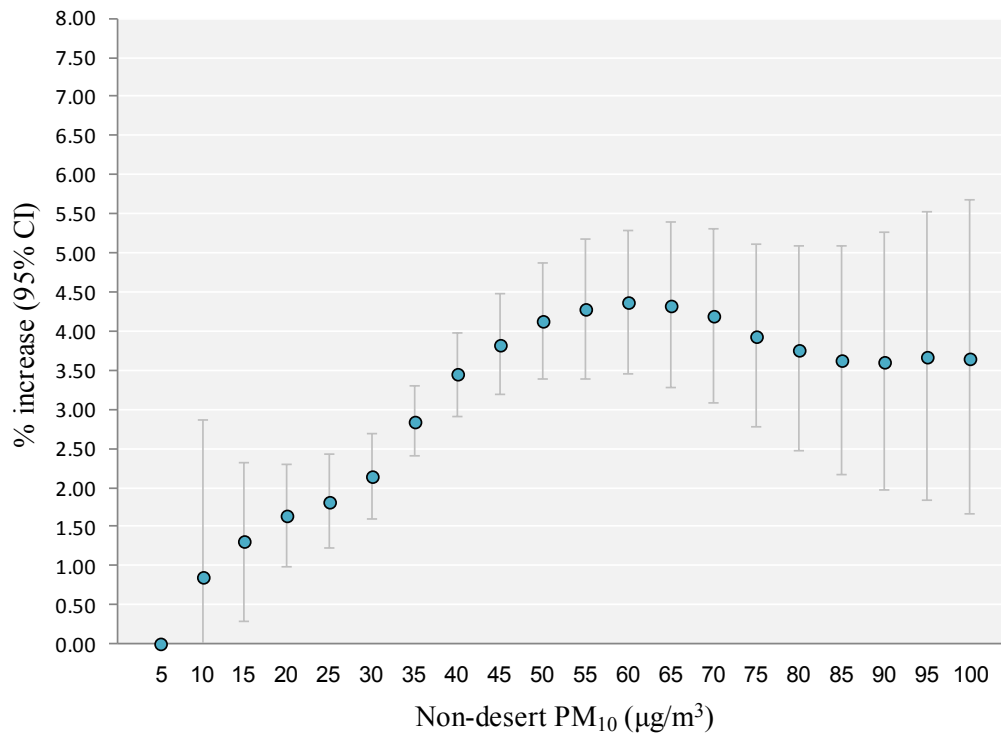
City <sup>a</sup>	Study period	Natural mortality	Cardiovascular mortality	Respiratory mortality	Cardiovascular admissions age 15+	Respiratory admissions age 15+	Respiratory admissions age 0-14
Milan	2007-2010	35	12	3	39	19	5
Turin	2006-2010	20	8	2	27	12	3
Emilia-Romagna <sup>b</sup>	2008-2010	13	5	1	18	9	1
Bologna	2006-2010	11	4	1	19	8	1
Marseille	2006-2008	21	6	1	-	-	-
Rome	2005-2010	58	24	4	81	29	8
Barcelona	2003-2010	42	13	5	52	48	6
Thessaloniki	2007-2009	18	8	2	-	-	-
Madrid	2001-2009	60	18	9	106	83	24
Palermo	2006-2009	15	6	1	17	7	3
Athens	2007-2009	81	36	9	-	-	-

<sup>a</sup> Ordered by latitude, North to South

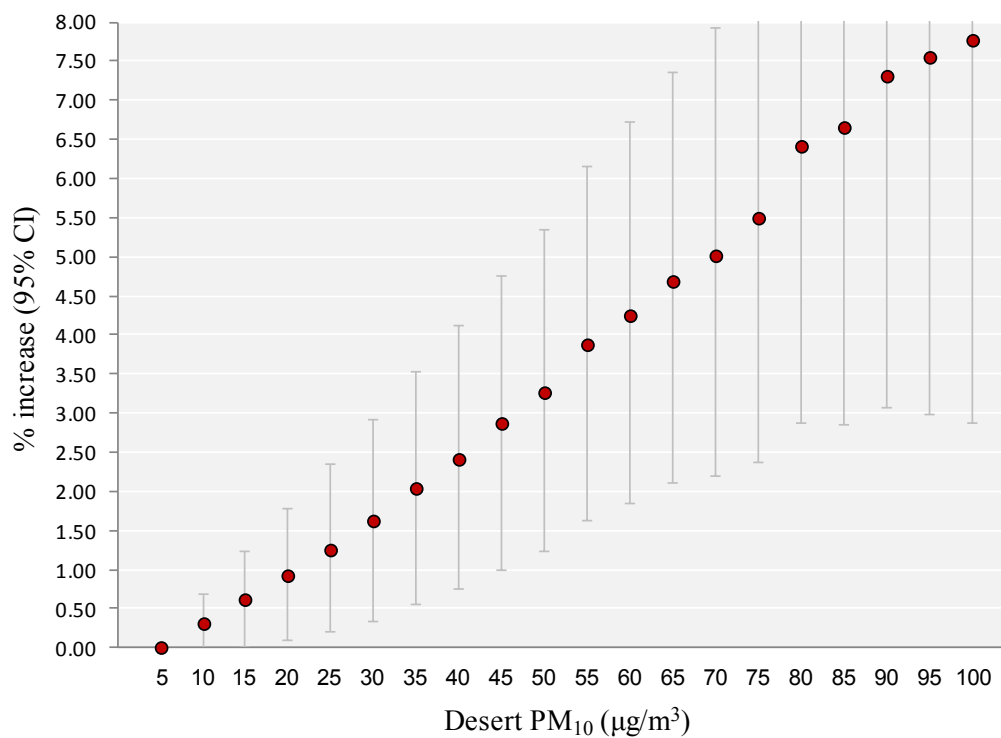
<sup>b</sup> Emilia Romagna includes the cities of Parma, Reggio Emilia, and Modena



(A)



(B)



**Figure S2.** Concentration–response relationship between non-desert PM<sub>10</sub> (A) and desert PM<sub>10</sub> (B) with natural mortality, lag 0-1. Values are estimated percent increases (95% CI) of total natural mortality associated with increases of PM<sub>10</sub> levels relative to 5 µg/m<sup>3</sup>

**Table S4.** P-values of the city-specific likelihood-ratio tests comparing the models with natural spline and linear term for non-desert PM<sub>10</sub> and desert PM<sub>10</sub> exposures versus natural mortality

City	p-value likelihood-ratio test spline model VS linear model	
	desert PM <sub>10</sub>	Non-desert PM <sub>10</sub>
Milan	0.649	0.006
Turin	0.084	0.415
Emilia-Romagna	0.033	0.847
Bologna	0.359	0.642
Marseille	0.277	0.205
Rome	0.323	0.312
Barcelona	0.242	0.031
Thessaloniki	0.803	0.631
Madrid	0.085	0.071
Palermo	0.211	0.178
Athens	0.565	0.075