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Supplement of

Joint analysis of continental and regional background environments in the Western Mediterranean: PM_1 and PM_{10} concentrations and composition

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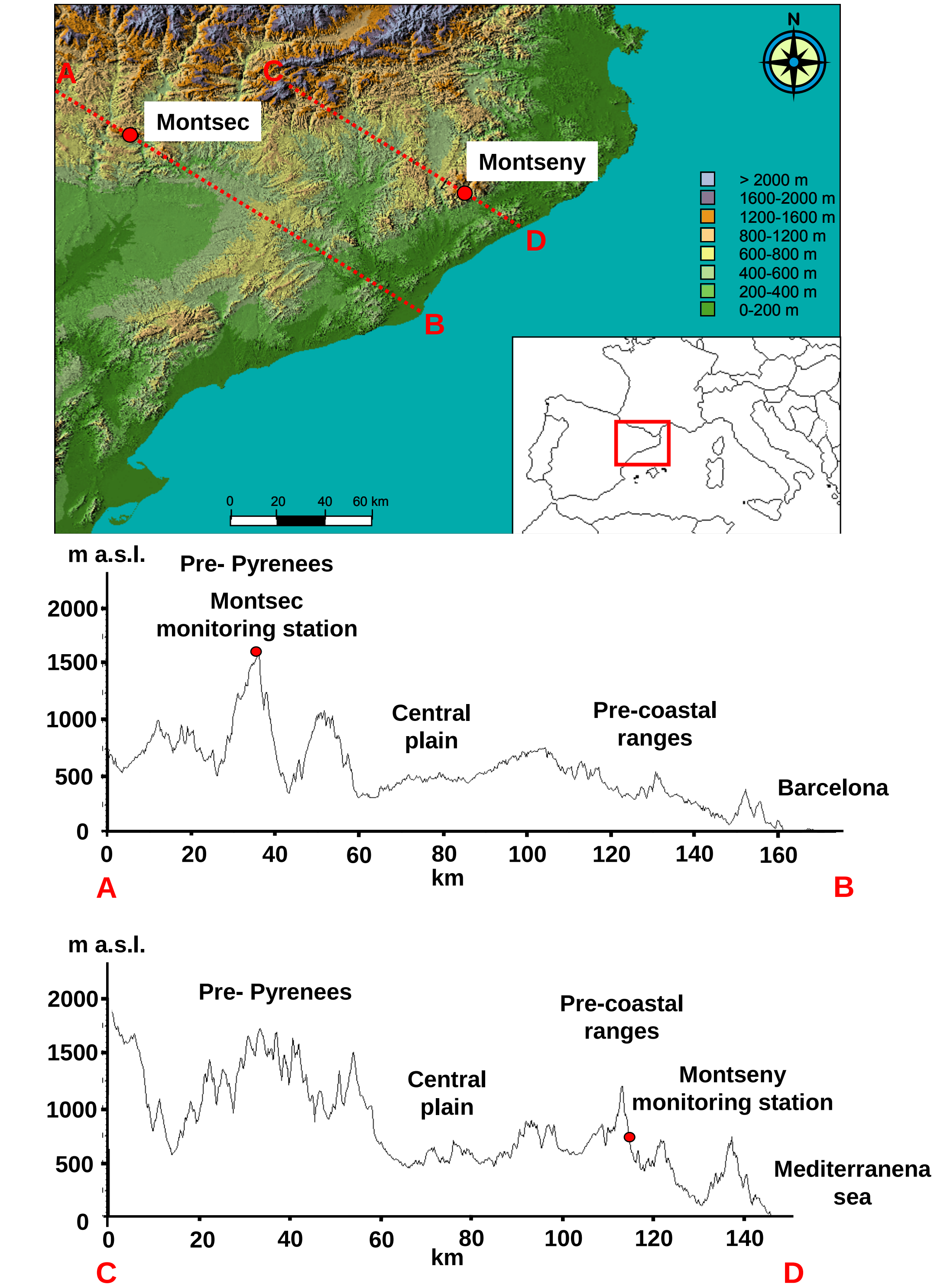


Fig. S1 Top: location of the two monitoring stations (Montsec and Montseny). Bottom: topography of the Montsec and Montseny area.

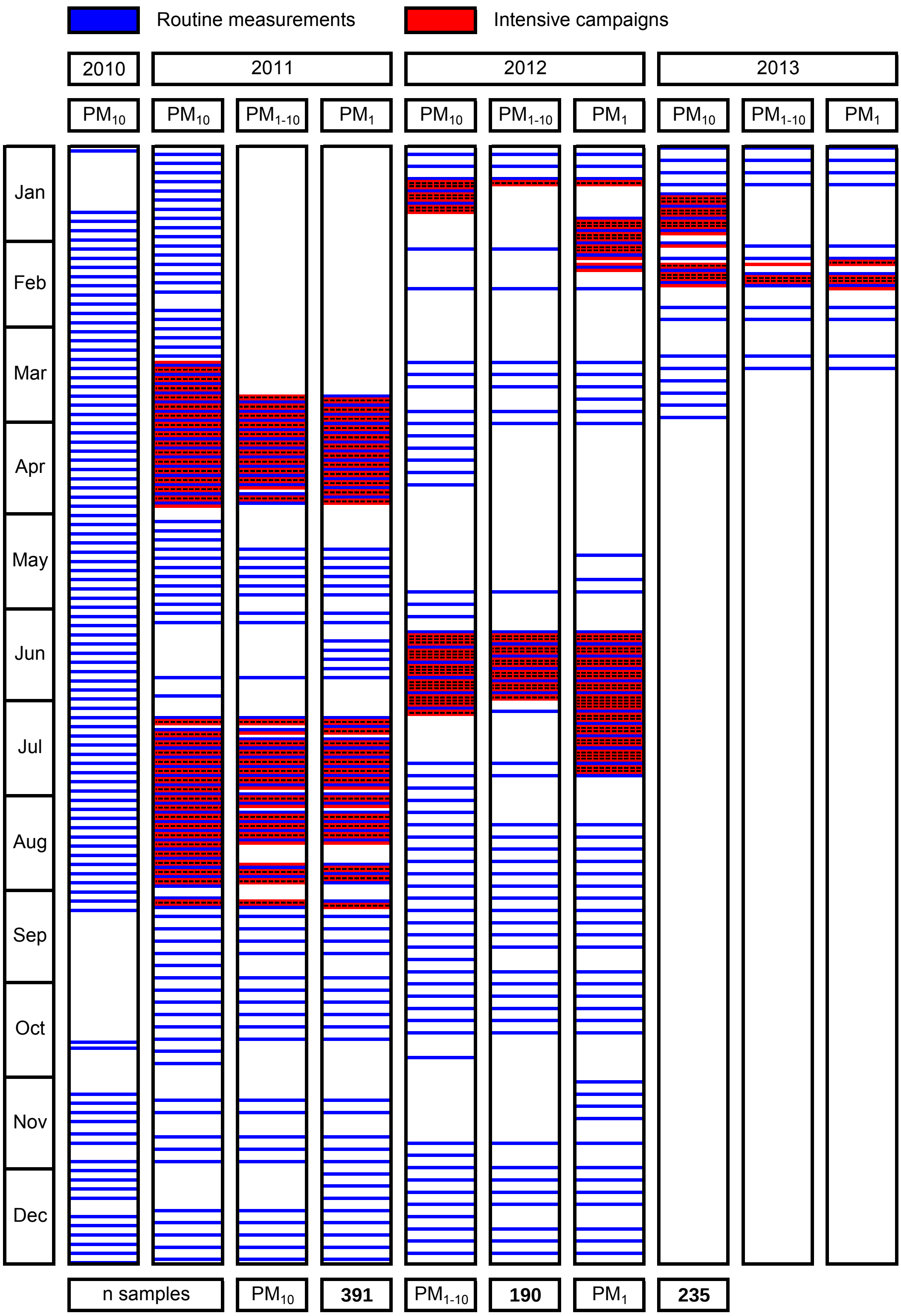


Fig. S2 Data schedule at Montsec (MSC).

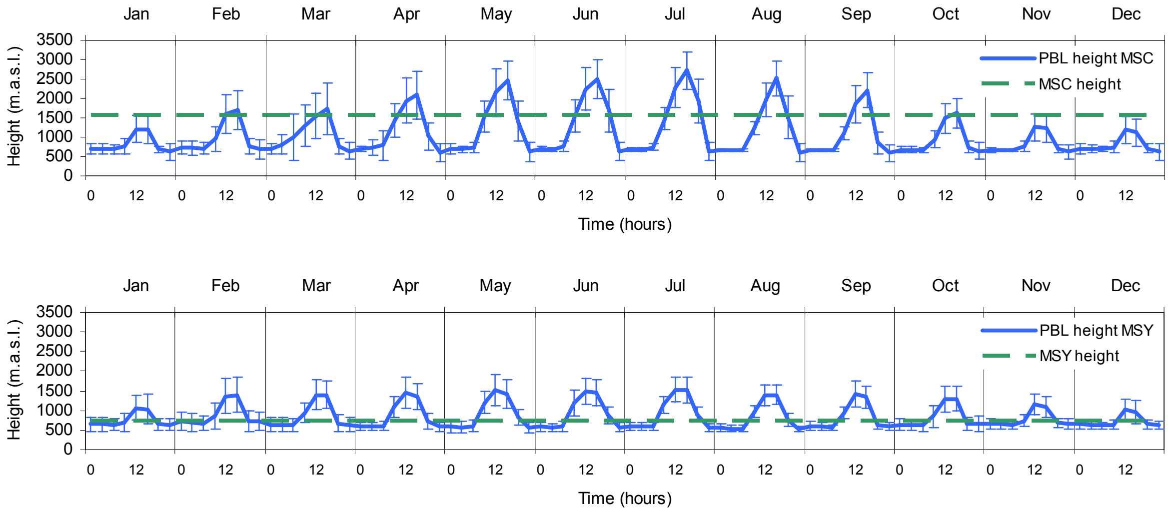


Fig. S3 Diurnal variation of the boundary layer height (computed with HYSPLIT model) averaged for each month during the study period at Montsec (MSC) and Montseny (MSY).

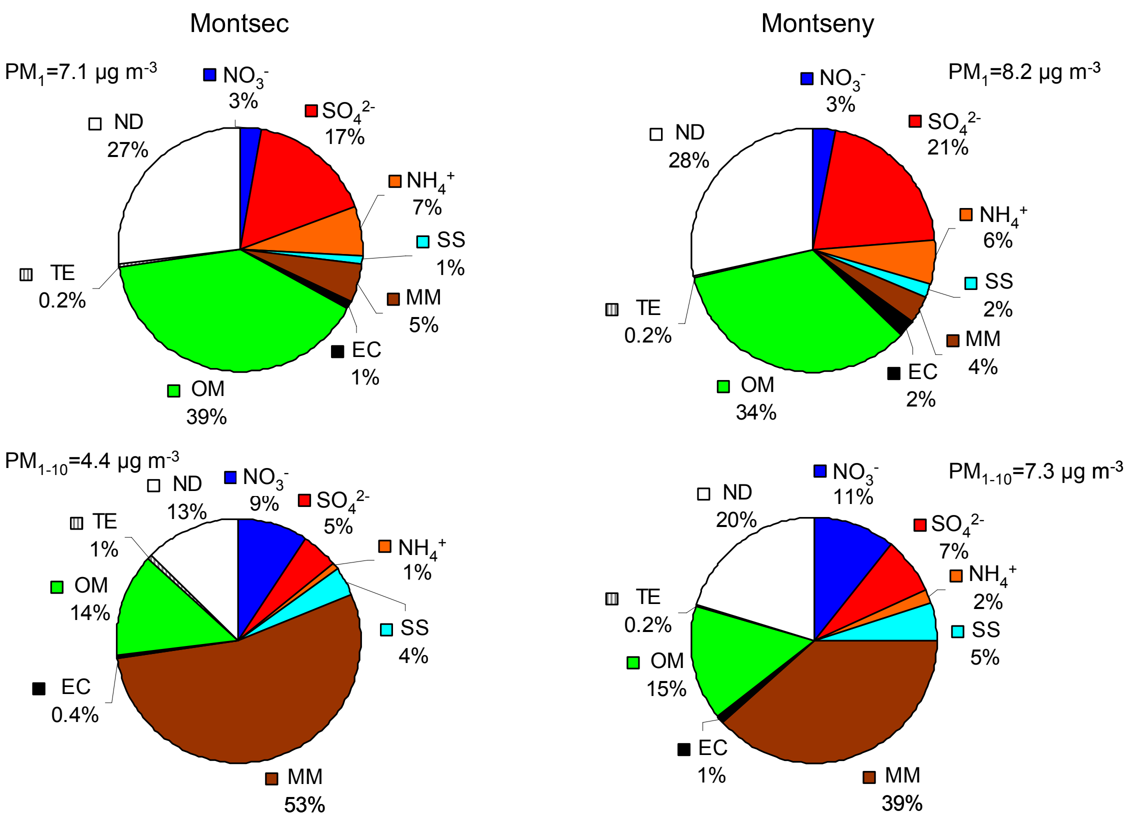
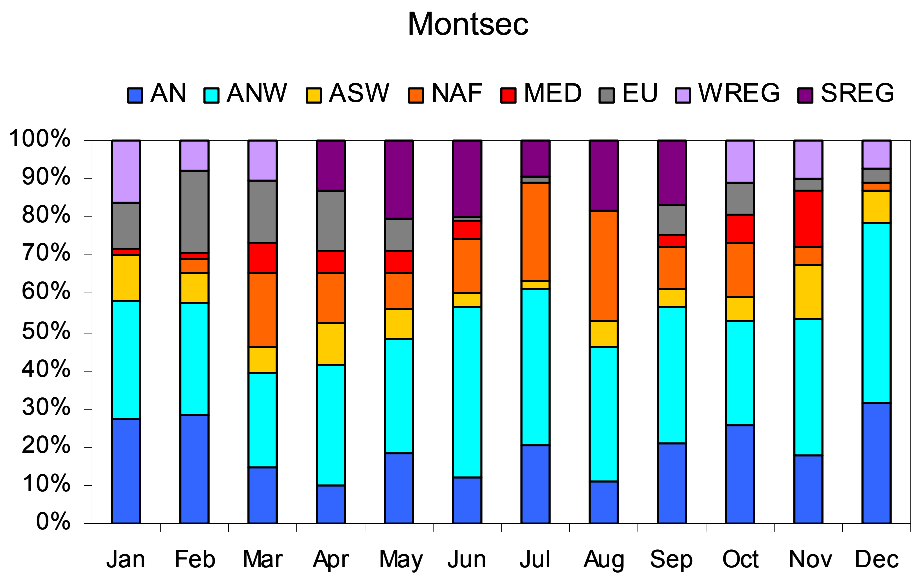


Fig. S4 Relative contributions of aerosol major components and trace elements (TE) to the total mass (%) and the total mass average concentration (µg m-3) in PM1 and PM1-10 fractions at Montsec and Montseny based on daily measurements between January 2010 and March 2013.



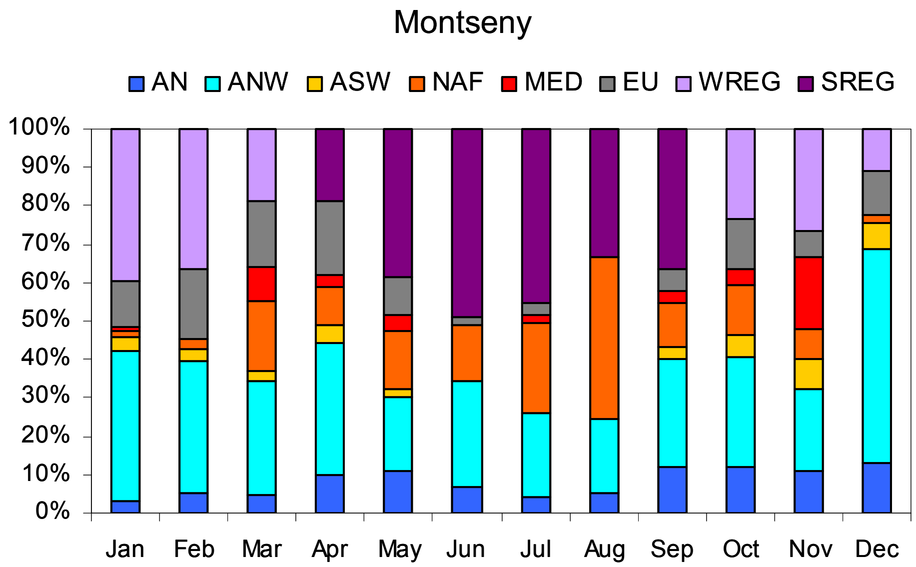


Fig. S5 Average frequency of air mass origin at Montsec and Montseny for the different months based on daily calculations between January 2010 and March 2013.

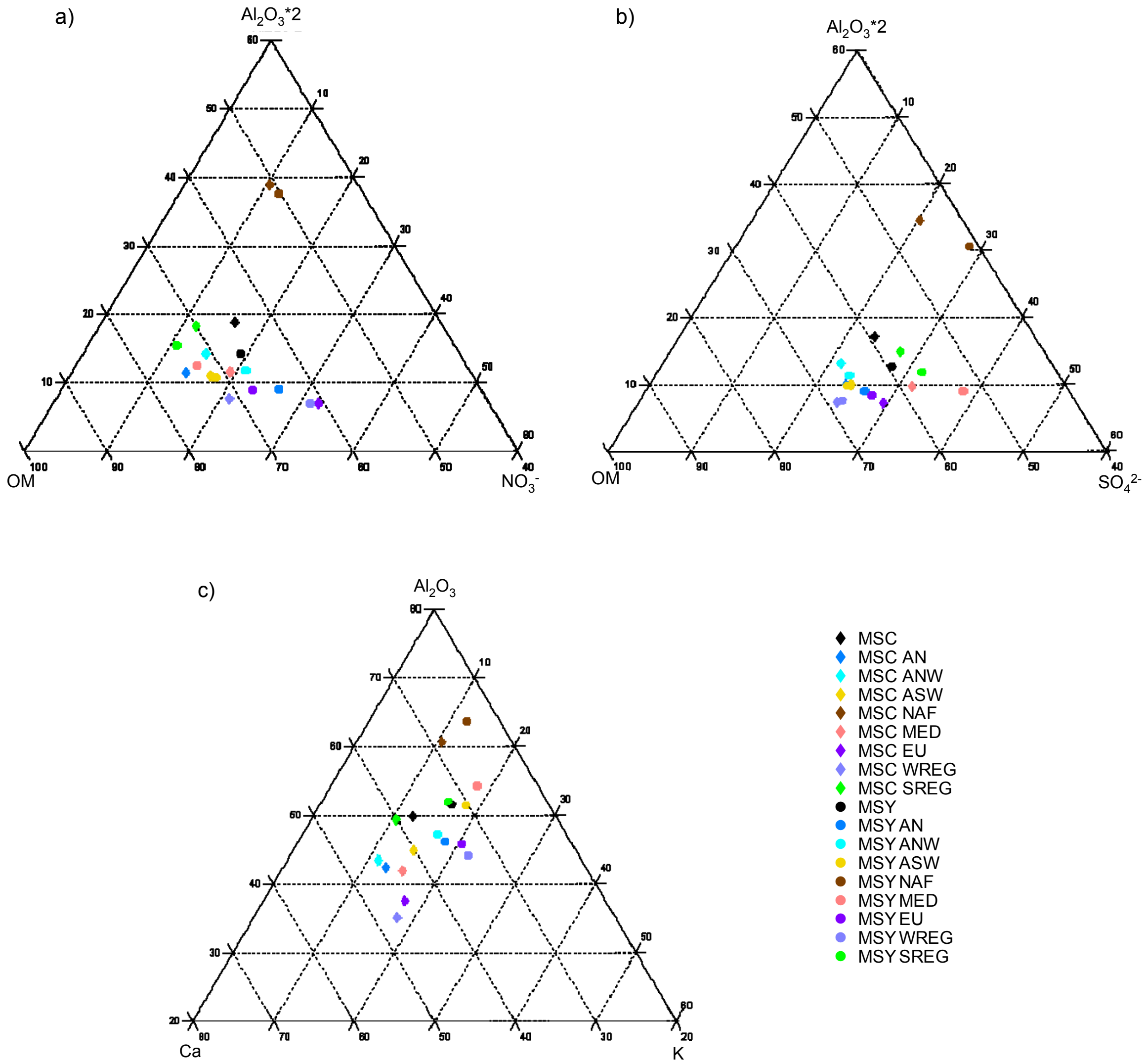


Fig. S6 Ternary plot of (a) organic matter (OM), aluminium oxide (Al_2O_3*2) and nitrate (NO_3^-), (b) organic matter (OM), aluminium oxide (Al_2O_3*2) and sulfate (SO_4^{2-}), and (c) calcium (Ca), aluminium oxide (Al_2O_3) and potassium (K) average concentrations of PM_{10} and average concentrations for different air mass origins at Montsec (MSC) and Montseny (MSY) based on daily measurements between January 2010 and March 2013.

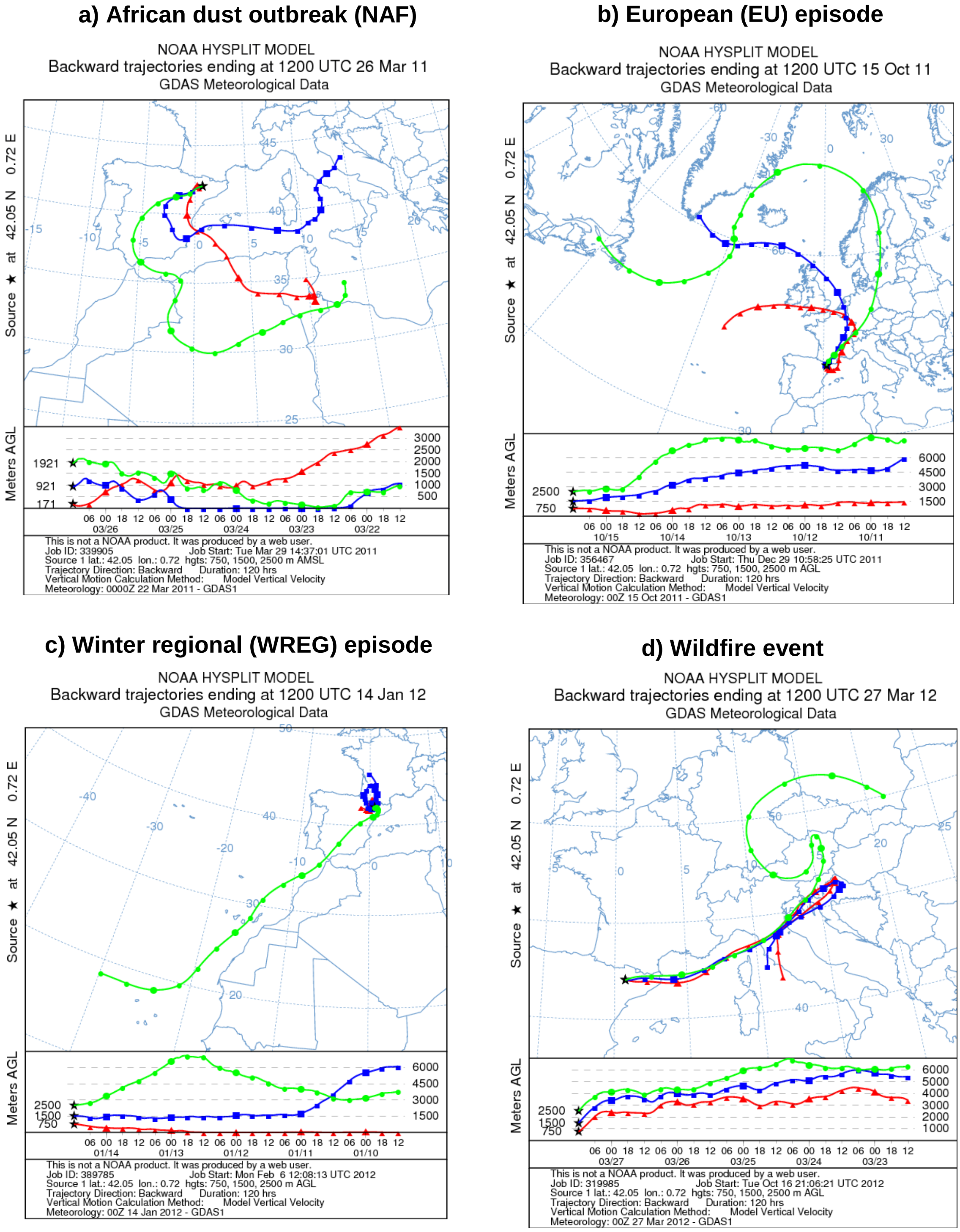
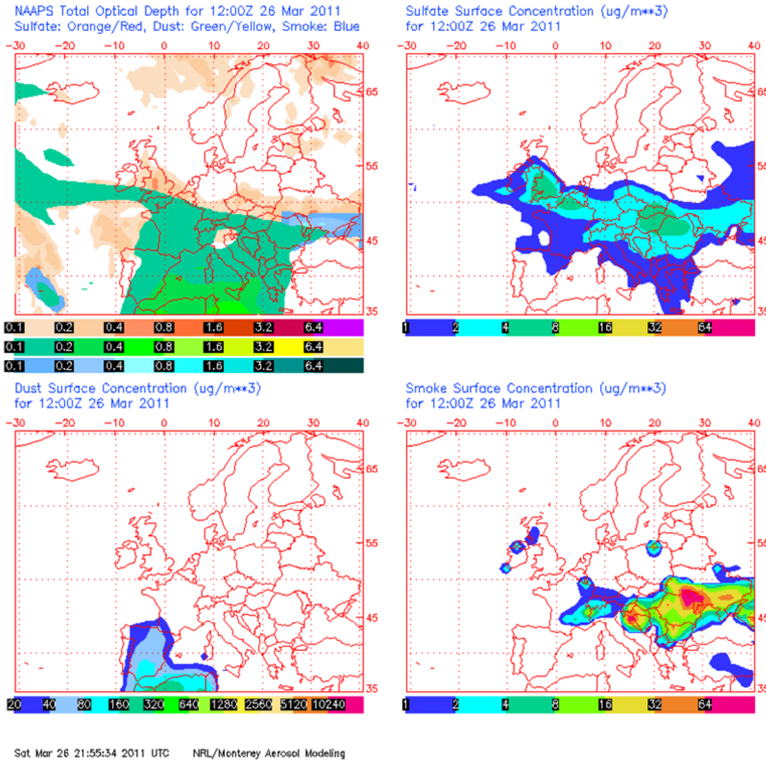
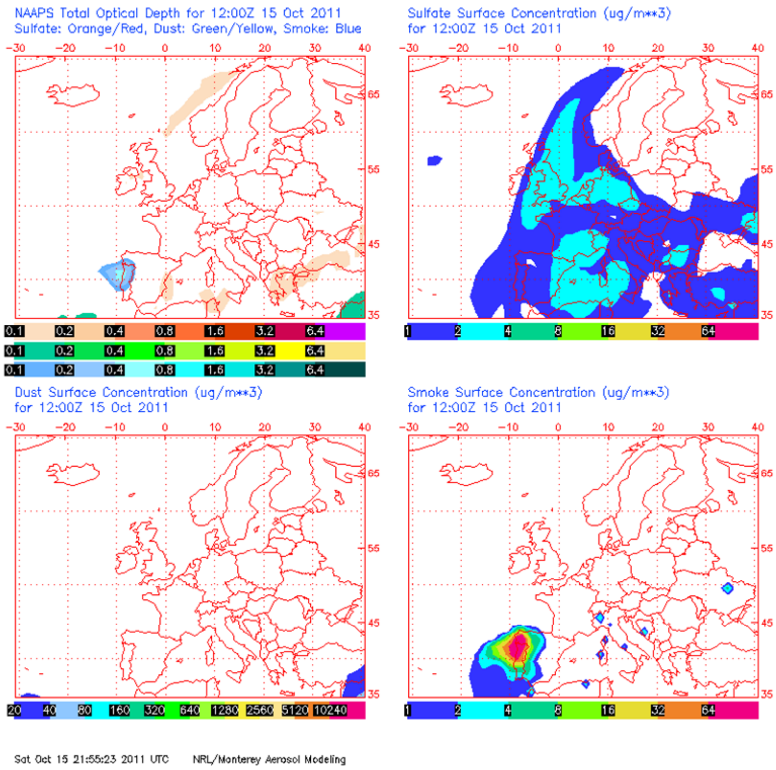


Fig. S7 Backward trajectories corresponding to 4 examples of different episodes affecting the study area, (a) African dust outbreak, (b) European episode, (c) winter regional episode, and (d) wildfire event.

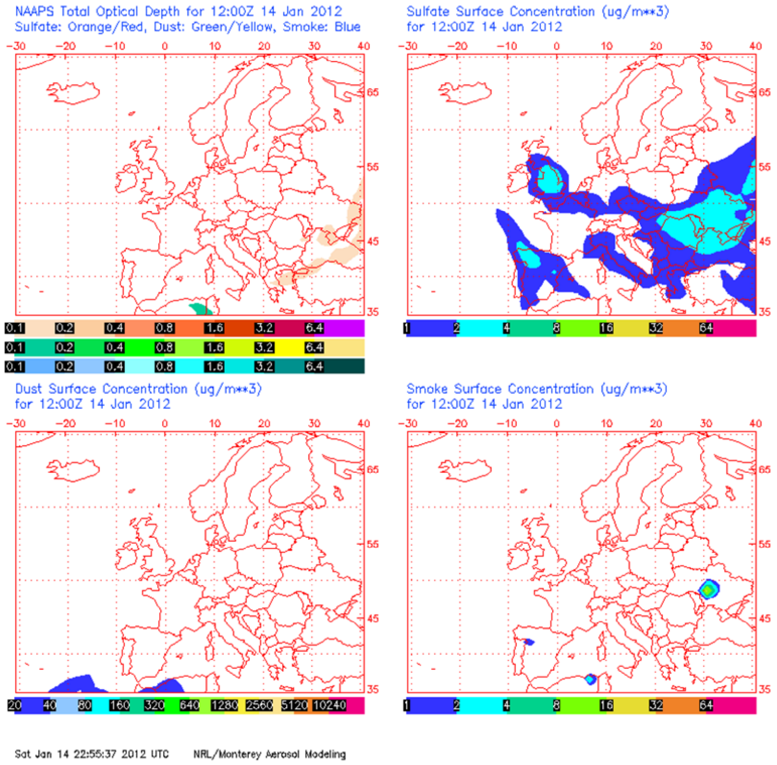
a) African dust outbreak (NAF)



b) European (EU) episode



c) Winter regional (WREG) episode



d) Wildfire event

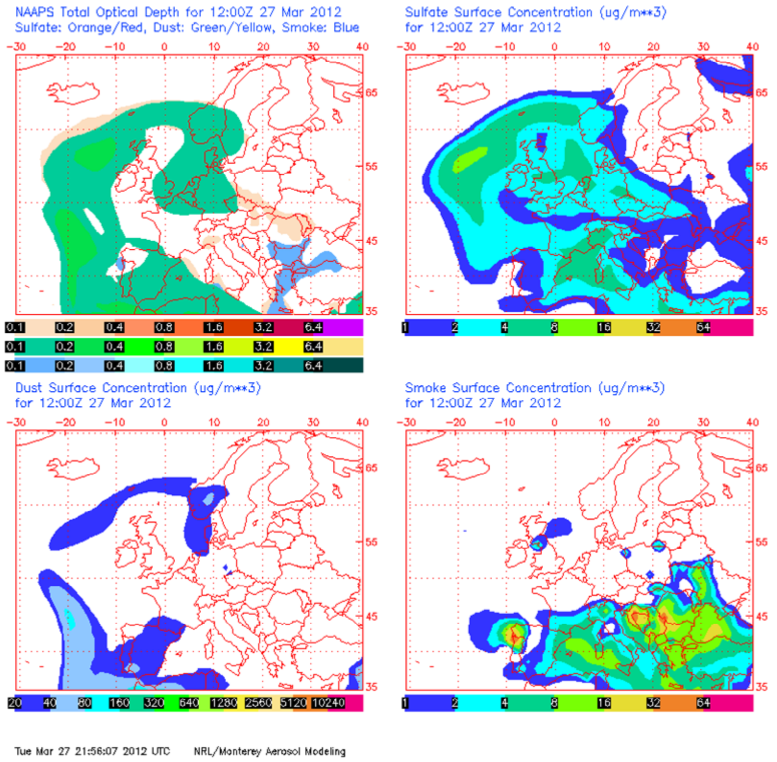


Fig. S8 Total optical depth, sulfate surface concentration, dust surface concentration, and smoke surface concentration from the NAAPS model corresponding to 4 examples of different episodes affecting the study area, (a) African dust outbreak, (b) European episode, (c) winter regional episode, and (d) wildfire event.

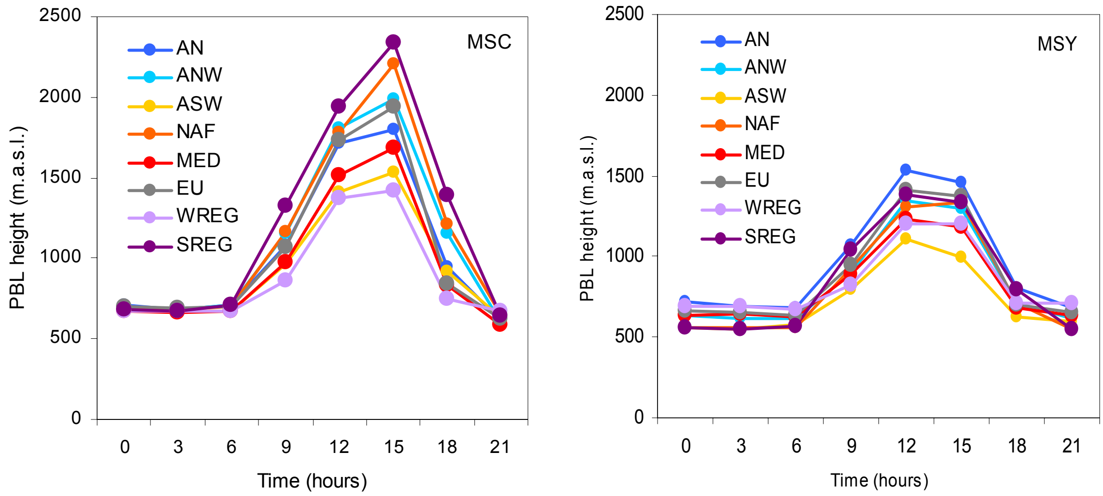


Fig. S9 Diurnal variation of the boundary layer height (computed with HYSPLIT model) averaged as a function of air mass origin during the study period at Montsec (MSC) and Montseny (MSY).

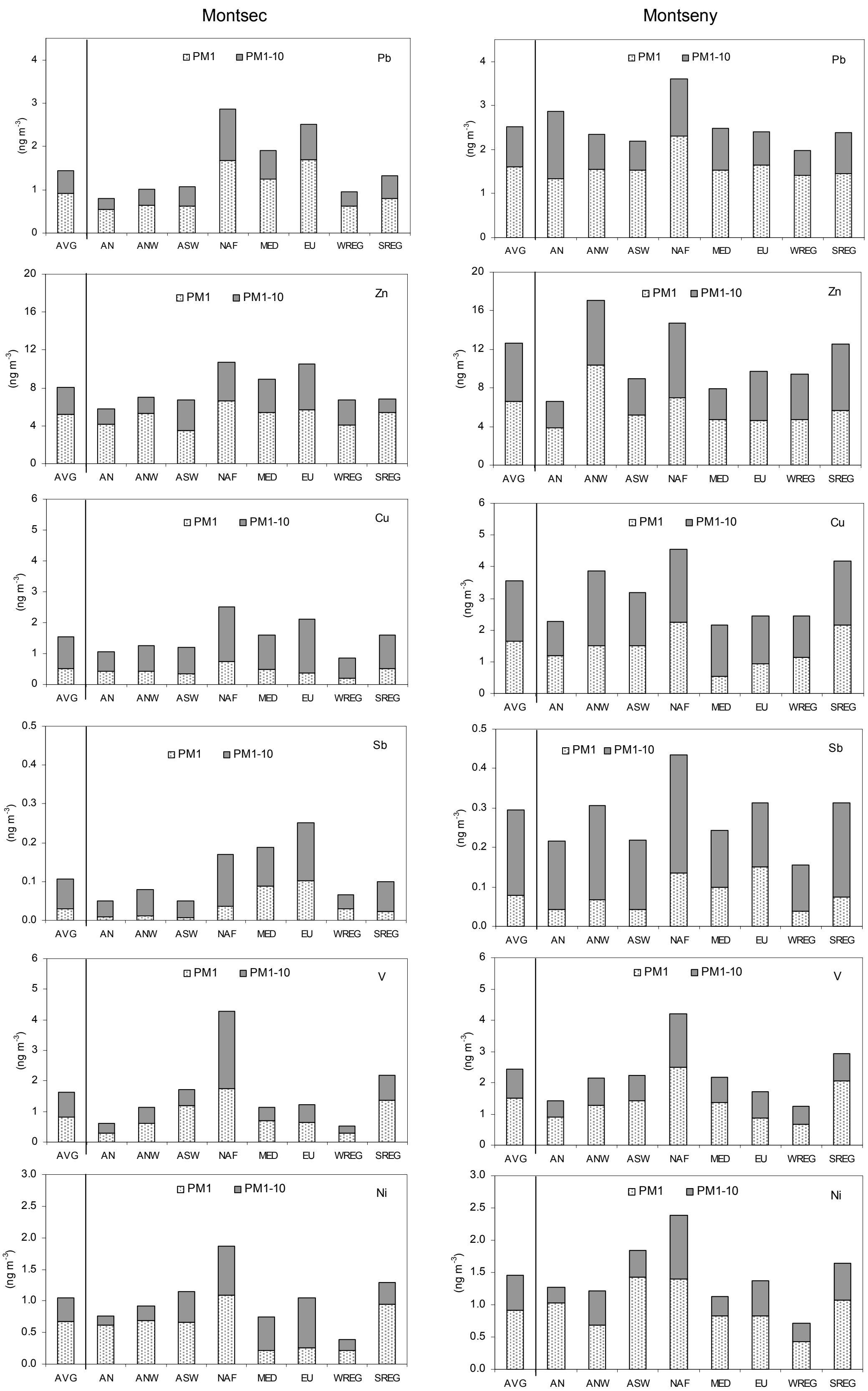


Fig. S10 Average (AVG) concentrations of PM_1 and PM_{1-10} lead (Pb), zinc (Zn), copper (Cu), antimony (Sb), vanadium (V), and nickel (Ni) at Montsec and Montseny for different air mass origins based on daily measurements between January 2010 and March 2013.

Table S1 Average (and standard deviation for MSC and MSY sites) of PM chemical components at different continental and regional background stations in Europe.

	Montsec (1570 m a.s.l.)				Puy de Dôme (1465 m a.s.l.)[1]		Montseny (720 m a.sl.)				Payerne (489 m a.s.l.)[2]	Magadino (200 m a.s.l.)[2]
	January 2010- March 2013				April 2006 - April 2007		January 2010- March 2013				August 2008 - July 2009	August 2008 - July 2009
	PM_{10}	N=273	PM_1	N=137	PM_{10}	PM_1	PM_{10}	N=249	PM_1	N=240	PM_{10}	PM_{10}
	AVG	SD	AVG	SD	AVG	AVG	AVG	SD	AVG	SD	AVG	AVG
PM mass (µg m^{-3})	**11.5**	**9.3**	**7.1**	**3.9**	**5.6**	**3.9**	**15.5**	**7.9**	**8.2**	**4.1**	**19.1**	**20.9**
Undet (µg m^{-3})	**2.4**	**1.6**	**2.1**	**1.2**	**3.4**	**2.2**	**4.3**	**2.7**	**3.6**	**2.7**	**3.2**	**2.7**
EC (µg m^{-3})	0.12	0.09	0.09	0.07	-	-	0.23	0.13	0.17	0.10	0.7	1.5
OM (µg m^{-3})	3.2	1.8	2.8	1.5	-	-	4.0	1.8	2.9	1.3	5.6	8.8
NO_3^- (µg m^{-3})	0.8	1.0	0.2	0.4	0.5	0.3	1.2	1.2	0.3	0.5	3.8	2.1
NH_4^+ (µg m^{-3})	0.5	0.5	0.5	0.4	0.3	0.3	0.5	0.5	0.5	0.4	1.6	1.2
SO_4^{2-} (µg m^{-3})	1.3	1.1	1.2	1.0	1.4	1.2	1.9	1.4	1.5	1.1	1.9	1.9
Sea salt (µg m^{-3})	**0.3**	**0.3**	**0.07**	**0.1**	**-**	**-**	**0.5**	**0.5**	**0.14**	**0.2**	-	-
Cl^- (µg m^{-3})	0.1	0.2	0.1	0.1	-	-	0.3	0.3	0.1	0.2	0.03	0.05
ss-Na (µg m^{-3})	0.1	0.2	0.02	0.02	-	-	0.3	0.3	0.03	0.03	0.1	0.1
Mineral (µg m^{-3})	**3.0**	**5.7**	**0.26**	**0.4**	**-**	**-**	**2.8**	**3.2**	**0.25**	**0.5**	**1.8**	**1.9**
CO_3^{2-} (µg m^{-3})	0.5	0.7	0.05	0.04	-	-	0.4	0.4	<0.01	<0.01	-	-
SiO_2 (µg m^{-3})	1.1	2.7	0.1	0.2	-	-	1.1	1.4	0.1	0.3	-	-
Al_2O_3 (µg m^{-3})	0.5	1.1	0.03	0.1	-	-	0.4	0.6	0.04	0.1	-	-
nss-Na (µg m^{-3})	0.02	0.04	<0.01	<0.01	-	-	-	-	-	-	0.1	0.1
Al (µg m^{-3})	0.2	0.6	0.02	0.05			0.2	0.3	0.02	0.06	0.1	0.1
Ca (µg m^{-3})	0.3	0.4	0.03	0.02	-	-	0.3	0.3	0.01	0.03	0.2	0.1
K (µg m^{-3})	0.11	0.2	0.02	0.1	-	-	0.14	0.1	0.05	0.03	0.2	0.3
Mg (µg m^{-3})	0.1	0.1	0.01	0.01	-	-	0.1	0.1	<0.01	0.01	0.04	0.04
Fe (µg m^{-3})	0.1	0.3	0.01	0.02	-	-	0.2	0.2	0.01	0.01	0.1	0.3
P (ng m^{-3})	9	8	3	1.8	-	-	11.0	8.4	3.2	4.4	-	-
Ti (ng m^{-3})	14	35	1.1	2.2	-	-	12.4	16.1	0.8	1.2	2.2	4.9
Mn (ng m^{-3})	4	6	0.9	1.1	-	-	3.8	3.0	0.7	0.9	2.9	5.1
Trace elements (µg m^{-3})	**0.02**	**0.02**	**0.02**	**0.01**	**-**	**-**	**0.03**	**0.02**	**0.02**	**0.02**	**0.60**	**0.80**
Li (ng m^{-3})	0.2	0.4	0.01	0.02	-	-	0.2	0.2	0.01	0.02	-	-
Be (ng m^{-3})	0.01	0.02	<0.01	<0.01	-	-	<0.01	0.01	<0.01	<0.01	-	-
V (ng m^{-3})	1.1	1.4	0.7	0.8	-	-	2.0	1.5	1.2	1.1	0.5	0.6
Cr (ng m^{-3})	0.8	1.4	0.7	1.3	-	-	0.9	0.9	0.5	1.0	0.7	1.4
Co (ng m-3)	0.08	0.1	0.05	0.2	-	-	0.08	0.07	0.03	0.05	-	-
Ni (ng m^{-3})	0.5	1.0	0.4	1.1	-	-	1.1	0.8	0.8	0.8	0.7	0.9
Cu (ng m^{-3})	1.1	1.1	0.4	0.4	-	-	3	2	1.5	3	4	9
Zn (ng m^{-3})	7	4	5	3	-	-	10	7	6	14	19	21
As (ng m^{-3})	0.1	0.2	0.06	0.06	-	-	0.2	0.1	0.1	0.09	0.5	0.7
Se (ng m^{-3})	0.1	0.1	0.06	0.07	-	-	0.2	0.1	0.09	0.07	0.4	0.4
Rb (ng m^{-3})	0.3	0.6	0.05	0.05	-	-	0.3	0.3	0.07	0.04	0.5	0.6
Sr (ng m^{-3})	1.5	3	0.1	0.2	-	-	1.1	1.3	0.1	0.3	0.6	0.6
Zr (ng m^{-3})	3	4	3	4	-	-	3	3	3	3	-	-
Nb (ng m^{-3})	0.2	0.5	0.08	0.08	-	-	0.1	0.2	0.02	0.06	-	-
Cd (ng m^{-3})	0.03	0.03	0.02	0.02	-	-	0.06	0.04	0.05	0.05	0.09	0.1
Sn (ng m^{-3})	0.4	0.5	0.2	0.2	-	-	0.7	0.5	0.4	0.3	-	-
Sb (ng m^{-3})	0.06	0.1	<0.01	0.07	-	-	0.3	0.2	0.1	0.1	0.6	1.0
Cs (ng m^{-3})	0.02	0.04	<0.01	<0.01	-	-	0.01	0.02	<0.01	<0.01	-	-
Ba (ng m^{-3})	2	5	1.3	2	-	-	3	3	0.6	2.0	1.7	3
La (ng m^{-3})	0.2	0.3	0.06	0.05	-	-	0.1	0.2	0.03	0.04	0.05	0.07
Ce (ng m^{-3})	0.3	0.7	0.1	0.1	-	-	0.3	0.3	0.06	0.07	0.1	0.1
Pr (ng m^{-3})	0.04	0.08	0.01	0.02	-	-	0.03	0.04	<0.01	0.01	-	-
Nd (ng m^{-3})	0.2	0.3	0.05	0.06	-	-	0.1	0.1	0.02	0.04	0.04	0.05
Hf (ng m^{-3})	0.2	0.2	0.2	0.2	-	-	0.1	0.2	0.1	0.2	-	-
Tl (ng m^{-3})	<0.01	0.01	<0.01	<0.01	-	-	0.01	0.02	<0.01	0.01	-	-
Pb (ng m^{-3})	1.1	1.0	0.8	0.7	-	-	2	2	1.6	1.0	4	4
Bi (ng m^{-3})	0.02	0.03	0.01	0.02	-	-	0.1	0.2	0.05	0.06	0.07	0.08
Th (ng m^{-3})	0.06	0.1	0.02	0.07	-	-	0.05	0.07	0.02	0.04	-	-
U (ng m^{-3})	0.1	0.1	0.08	0.09	-	-	0.06	0.06	0.05	0.07	-	-

[1](Bourcier et al., 2012); [2](Gianini et al., 2012).

Table S2 Factor loadings resulting from the Principal Component Analysis (PCA), using Varimax rotation, on PM_{10} components from Montsec.

MSC				
Factor	Mineral	Industrial + traffic	Fuel oil combustion	Sea salt
Cl^-	0.14	0.05	-0.10	**0.84**
NO_3^-	0.12	**0.81**	-0.09	0.04
NH_4^+	-0.05	**0.88**	0.13	0.03
SO_4^{2-}	0.13	**0.71**	**0.50**	0.26
Al_2O_3	**0.97**	0.13	0.16	0.04
Ca	**0.75**	**0.33**	**0.31**	0.28
K	**0.87**	**0.34**	0.12	0.03
Na	0.29	0.25	**0.45**	**0.62**
Mg	**0.91**	0.19	0.23	0.21
Fe	**0.97**	0.15	0.16	0.04
Li	**0.96**	0.16	0.16	0.10
Ti	**0.96**	0.11	0.15	0.00
V	**0.68**	**0.42**	**0.45**	0.12
Cr	**0.46**	0.00	**0.56**	-0.08
Mn	**0.88**	0.21	0.25	0.13
Ni	**0.32**	0.23	**0.80**	-0.07
Cu	0.29	**0.57**	**0.44**	0.19
Zn	0.24	**0.67**	-0.02	-0.16
As	**0.62**	**0.50**	0.11	0.05
Se	0.30	**0.54**	**0.54**	0.18
Sr	**0.91**	0.17	0.20	0.19
Cd	**0.31**	**0.57**	0.11	0.06
Sb	0.13	**0.80**	0.22	0.12
Pb	**0.38**	**0.79**	0.27	-0.03
OC	**0.34**	**0.59**	**0.45**	0.23
EC	0.14	**0.82**	0.12	0.17
% Var	54	15	5	4

Factor loadings > 0.7 are marked in red, between 0.7 and 0.5 in dark gray, and between 0.5 and 0.3 in bright gray. % Var: percentage of the variance explained by each factor.

Table S3 Factor loadings resulting from the Principal Component Analysis (PCA), using Varimax rotation, on PM_{10} components from Montseny.

MSY				
Factor	Mineral	Industrial + traffic	Fuel oil combustion	Sea salt
Cl^-	0.05	-0.03	-0.07	**0.82**
NO_3^-	0.06	**0.73**	-0.05	0.24
NH_4^+	-0.05	**0.66**	**0.35**	-0.08
SO_4^{2-}	0.23	0.13	**0.88**	0.03
Al_2O_3	**0.97**	0.09	0.13	0.03
Ca	**0.90**	0.21	0.21	0.13
K	**0.89**	0.20	0.28	0.06
Na	0.24	-0.03	0.26	**0.76**
Mg	**0.91**	0.06	0.21	0.25
Fe	**0.75**	0.01	0.27	0.05
Li	**0.97**	0.13	0.06	0.07
Ti	**0.97**	0.11	0.13	0.02
V	**0.62**	0.20	**0.66**	0.07
Cr	**0.63**	0.28	0.20	-0.12
Mn	**0.93**	0.19	0.19	0.02
Ni	**0.43**	0.21	**0.70**	-0.03
Cu	0.12	**0.73**	-0.01	-0.03
Zn	0.14	**0.78**	0.19	0.08
As	**0.64**	**0.47**	**0.31**	0.03
Se	0.25	0.21	**0.61**	0.17
Sr	**0.96**	0.08	0.05	0.14
Cd	0.13	**0.83**	0.02	-0.07
Sb	0.13	**0.75**	0.19	-0.02
Pb	0.21	**0.57**	0.10	-0.13
OC	0.14	**0.52**	**0.53**	-0.02
EC	0.17	**0.69**	**0.37**	-0.02
% Var	46	16	6	5

Factor loadings > 0.7 are marked in red, between 0.7 and 0.5 in dark gray, and between 0.5 and 0.3 in bright gray. % Var: percentage of the variance explained by each factor.