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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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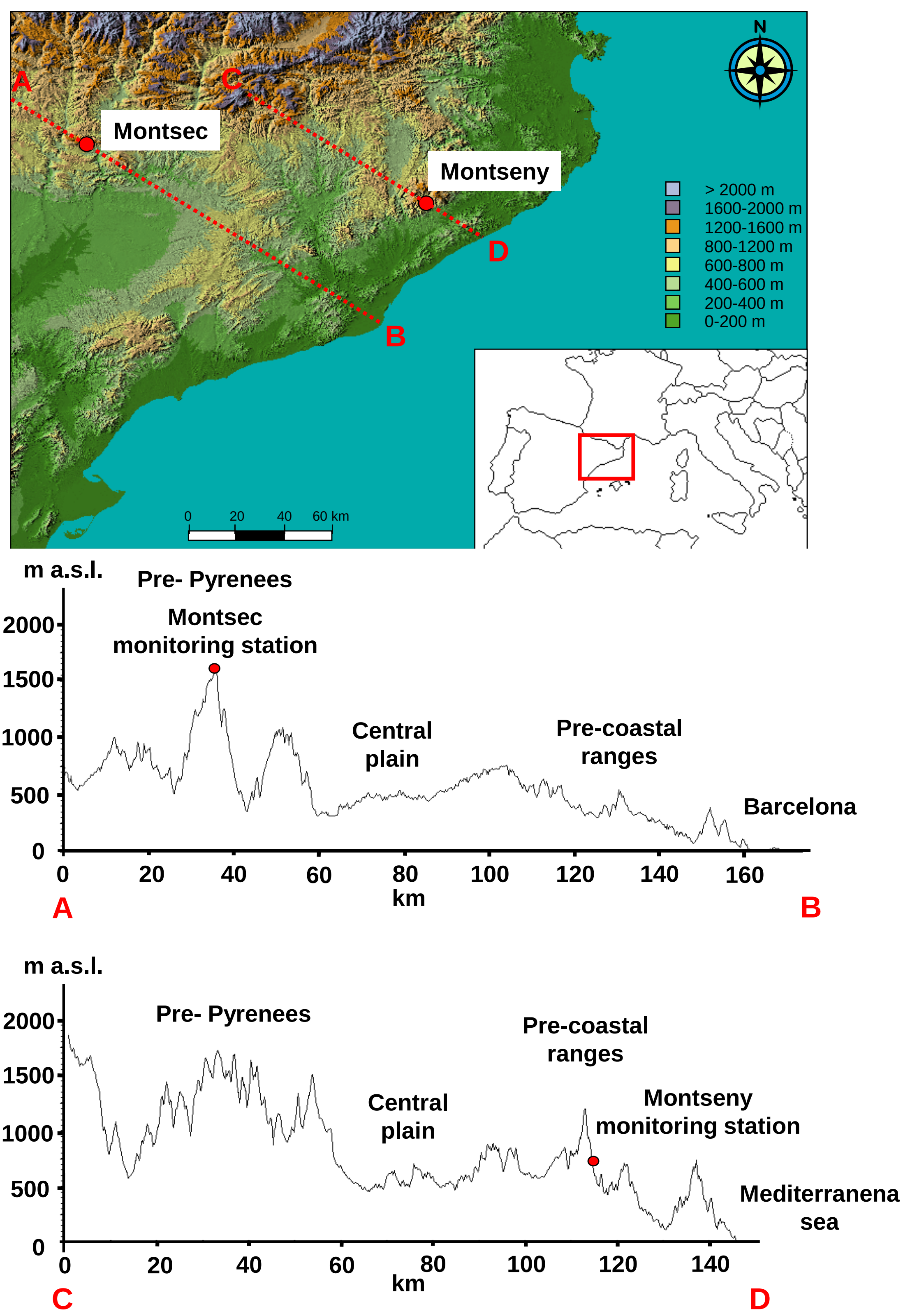


Fig. S1 Top: location of the two monitoring stations (Montsec and Montseny). Bottom: topography of the Montsec and Montseny area.

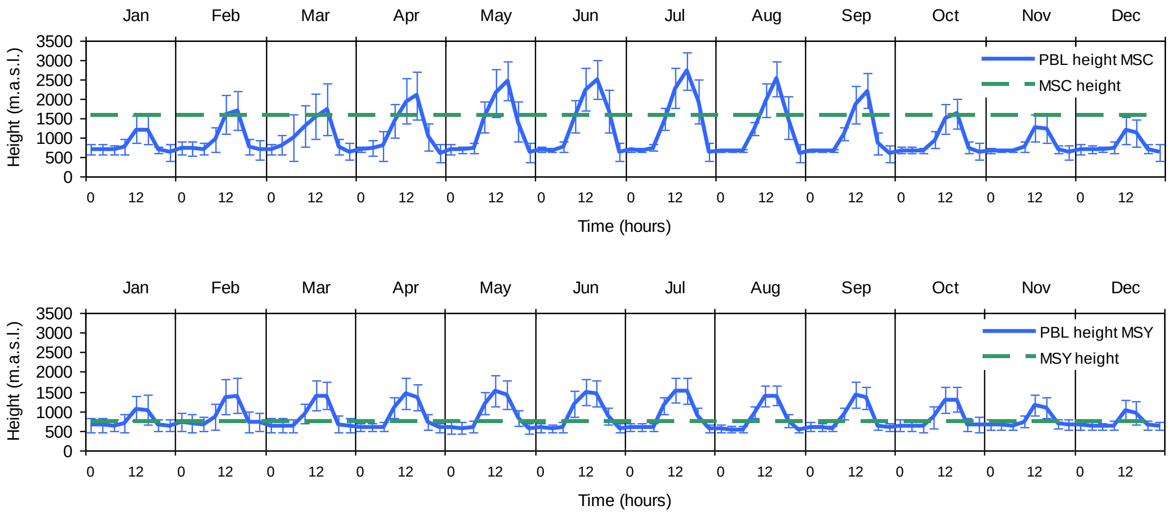


Fig. S2 Diurnal variation of the boundary layer height (computed with HYSPLIT model) averaged for each month at Montsec and Montseny between January 2010 and March 2013.

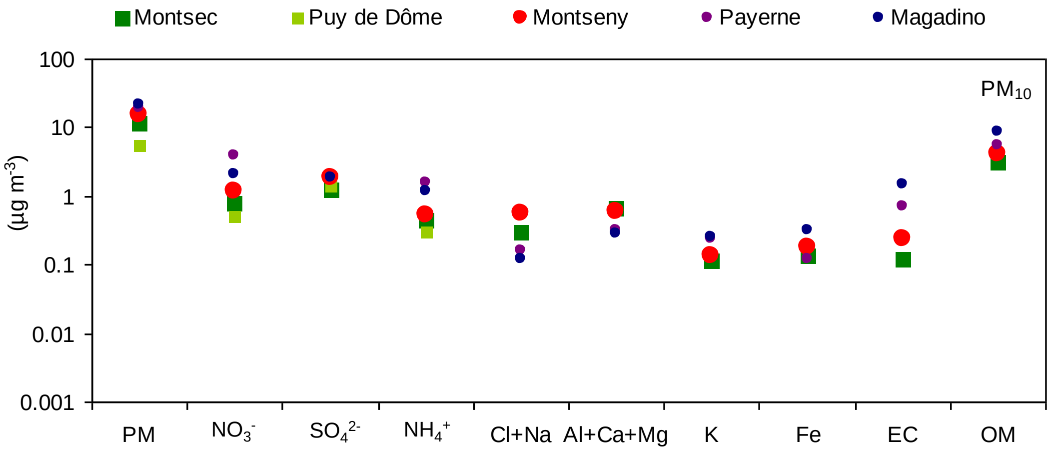


Fig. S3 Average concentrations of PM_{10} major compounds at Montsec (present study), Puy de Dôme (Bourcier et al., 2012), Montseny (present study), Payerne and Magadino (Gianini et al., 2012).

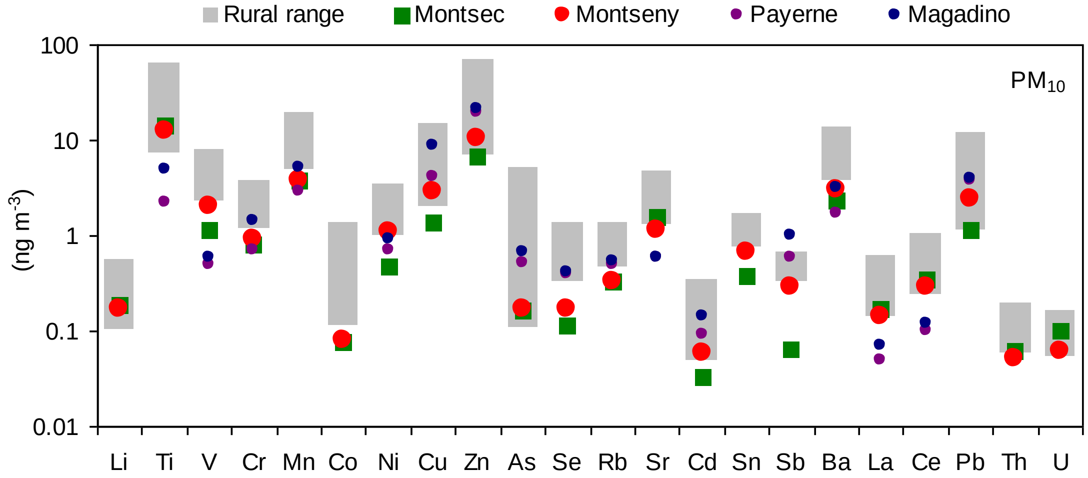


Fig. S4 Average concentrations of PM_{10} trace elements at Montsec and Montseny (present study), and at Payerne and Magadino (Gianini et al., 2012), and range of Spanish rural concentrations (updated from Querol et al., 2007)**.**

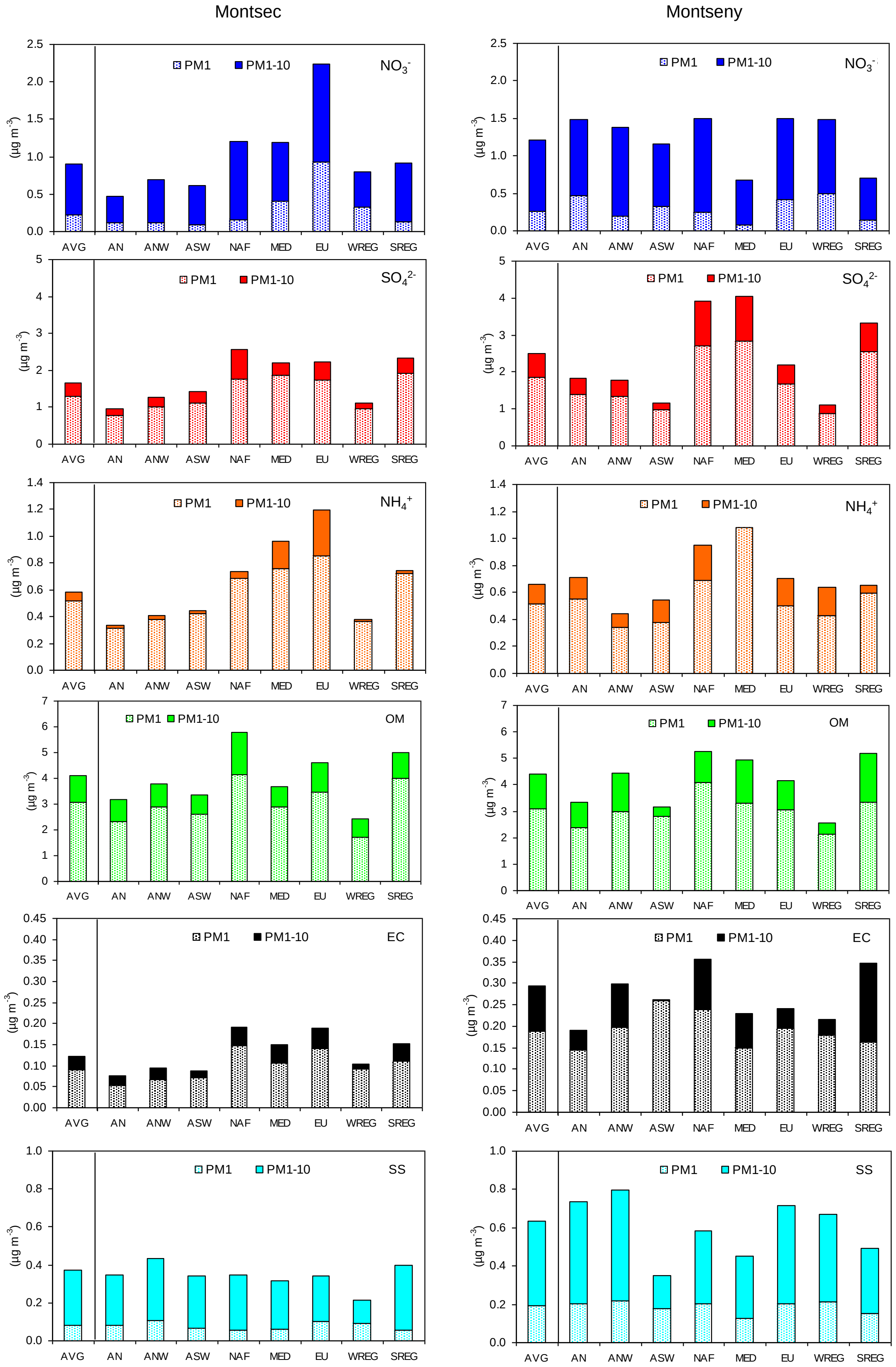


Fig. S5 Average (AVG) concentrations of PM_1 and $PM_{1\text{-}10}$ nitrate (NO3), sulfate (SO4), ammonium (NH4), elemental carbon (EC), organic matter (OM) and sea salt (SS) at Montsec and Montseny for different atmospheric episodes based on daily measurements between January 2010 and March 2013.

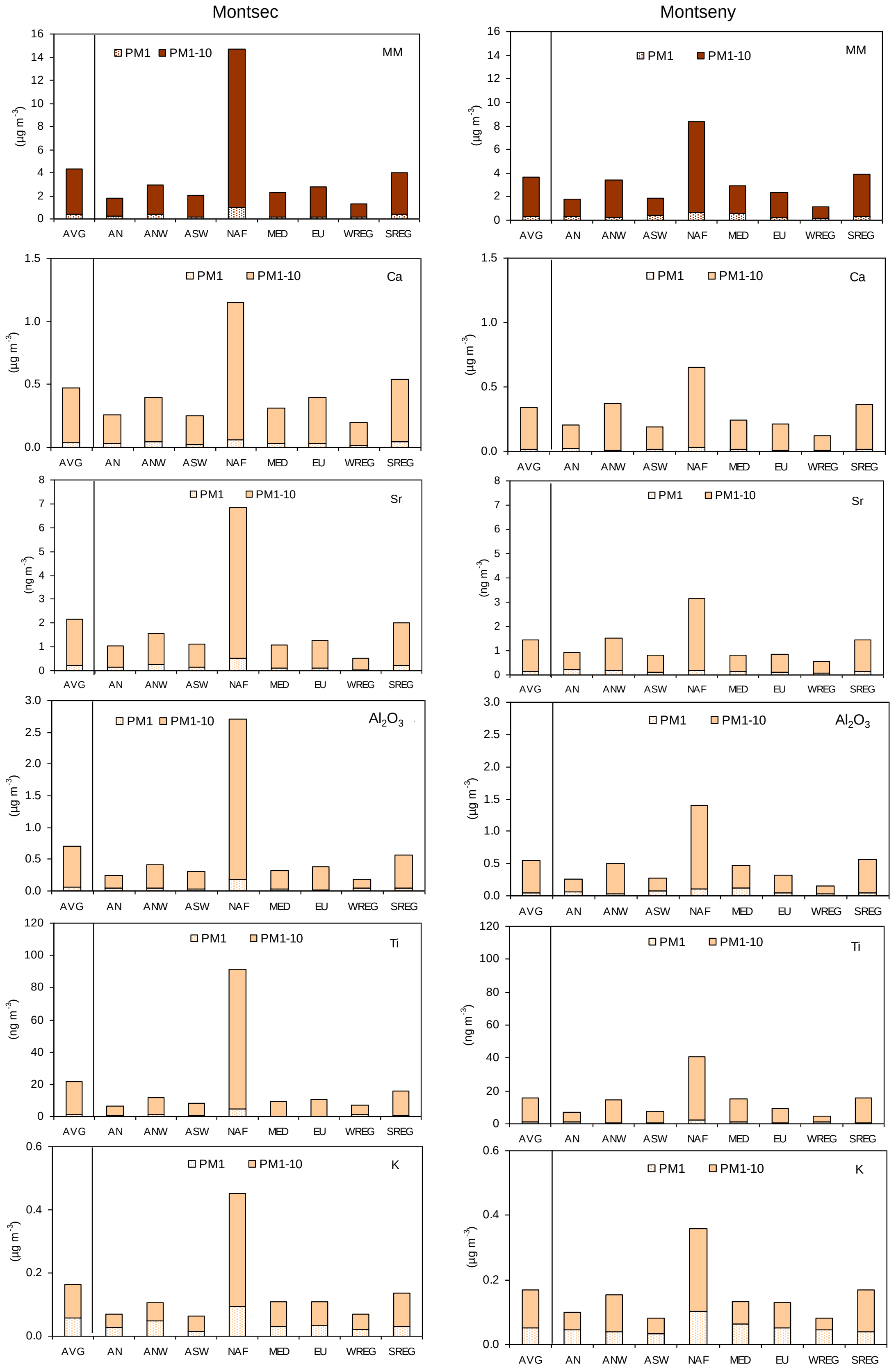


Fig. S6 Average (AVG) concentrations of PM_1 and PM_{1-10} mineral matter (MM), carbonate (CO32-), strontium (Sr), aluminium oxide (Al2O3), titanium (Ti) and potassium (K) at Montsec and Montseny for different atmospheric episodes based on daily measurements between January 2010 and March 2013.

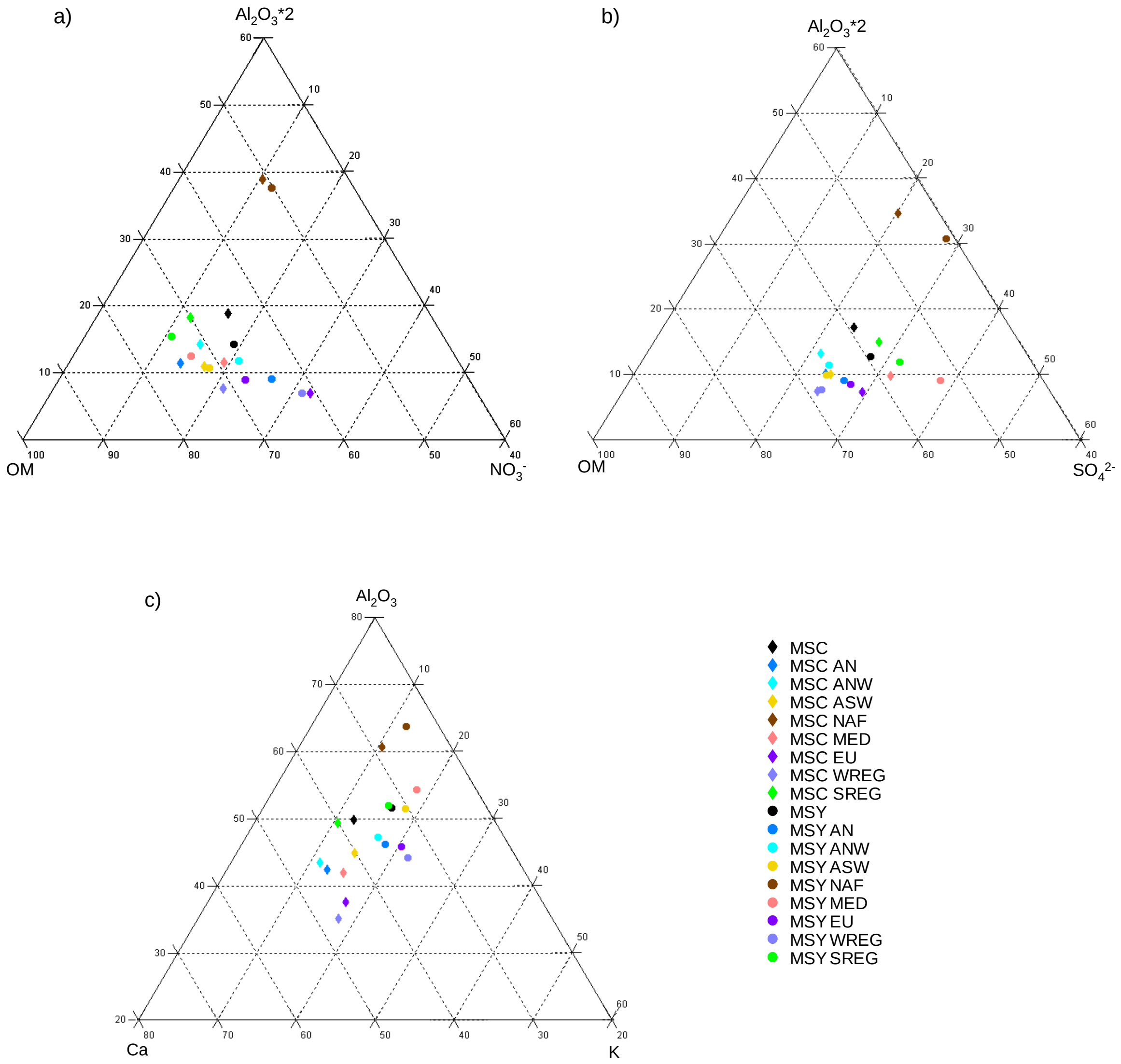


Fig. S7 Ternary plot of (a) organic matter (OM), aluminium oxide (Al_2O_3*2) and nitrate (NO_3^-), (b) organic matter (OM), aluminium oxide (Al_2O_3*2) and sulfate (SO_4^{2-}), and (c) calcium (Ca), aluminium oxide (Al_2O_3) and potassium (K) average concentrations of PM_{10} and average concentrations for different atmospheric episodes at Montsec (MSC) and Montseny (MSY) based on daily measurements between January 2010 and March 2013.

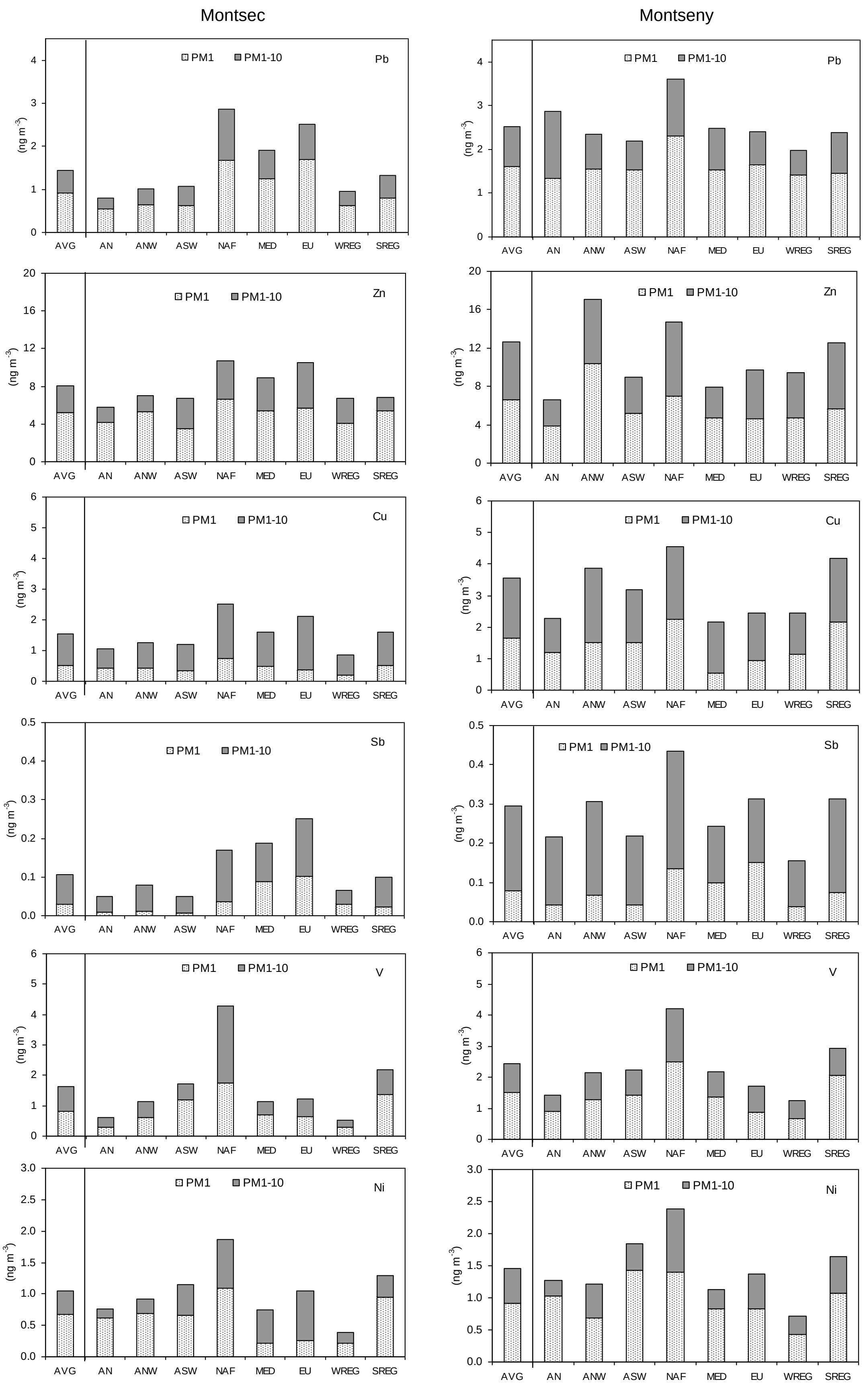


Fig. S8 Average (AVG) concentrations of PM_1 and PM_{1-10} vanadium (V), arsenic (As), cadmium (Cd), copper (Cu), lead (Pb) and antimony (Sb) at Montsec and Montseny

for different atmospheric episodes based on daily measurements between January 2010 and March 2013.

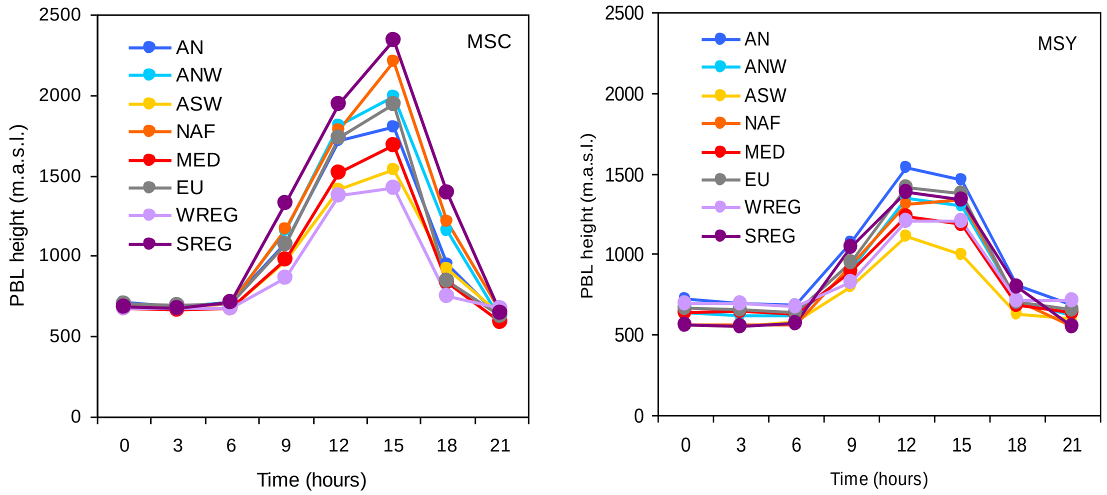


Fig. S9 Diurnal variation of the boundary layer height (computed with HYSPLIT model) averaged for different atmospheric episodes at Montsec (MSC) and Montseny (MSY) between January 2010 and March 2013.

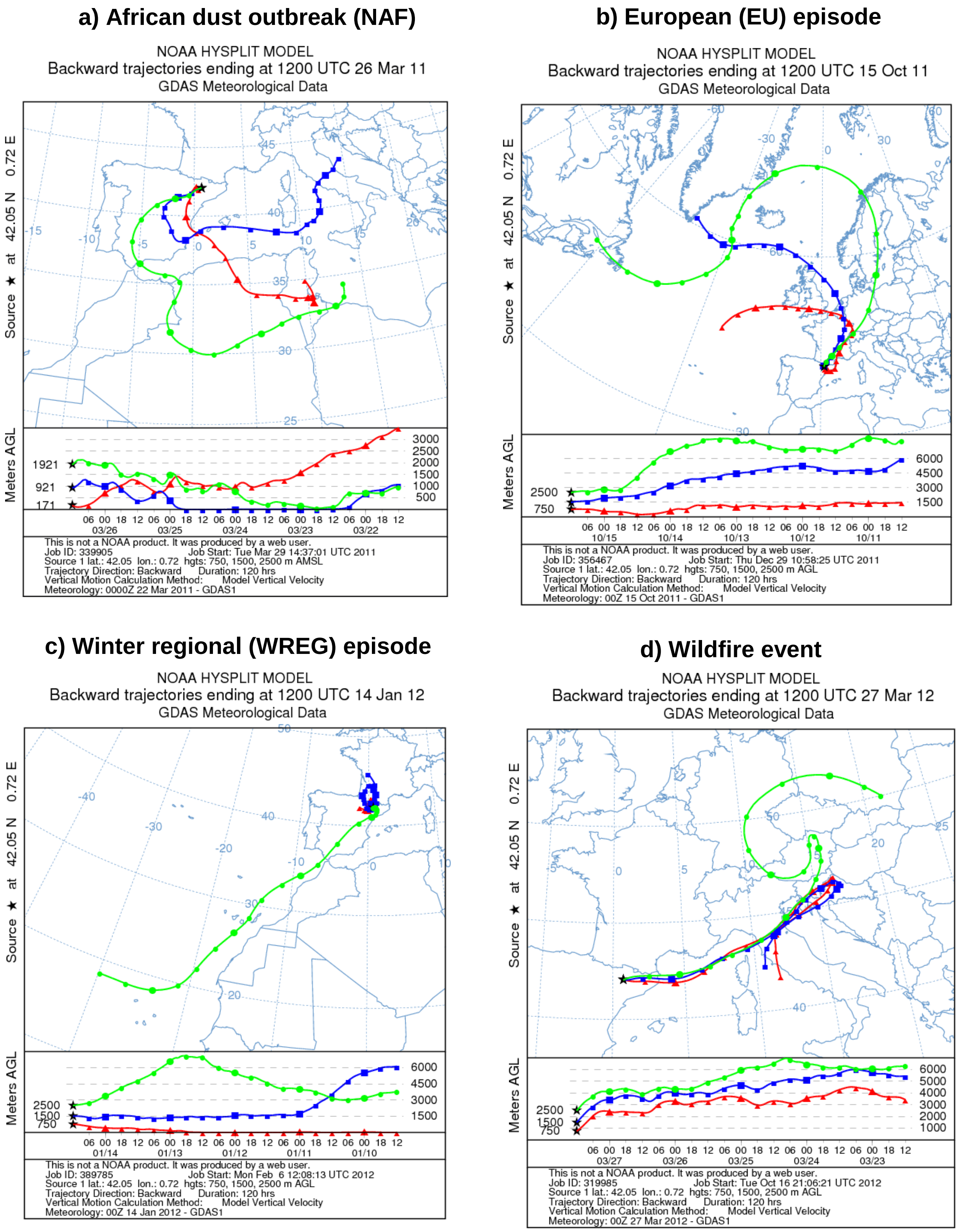
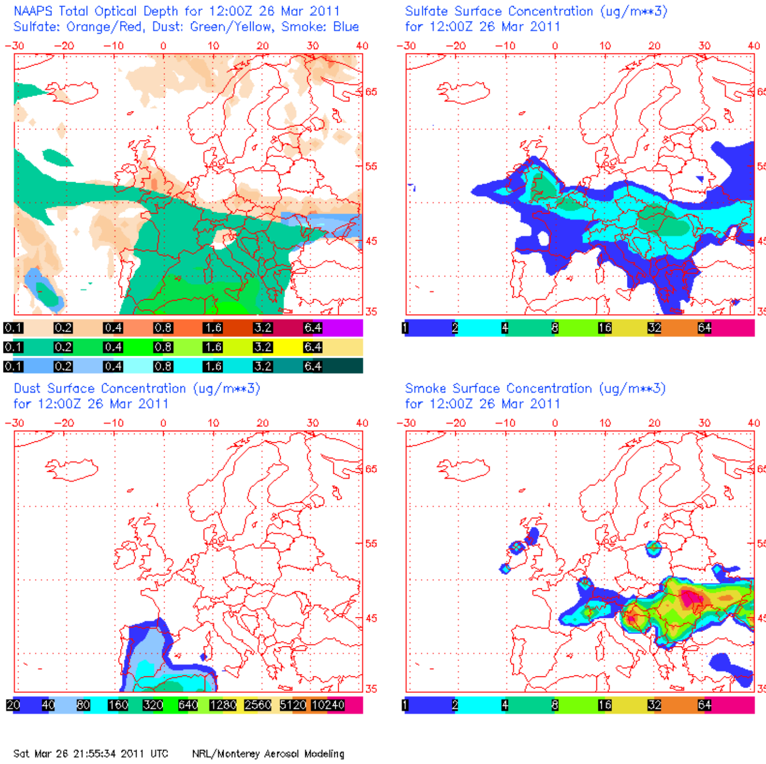
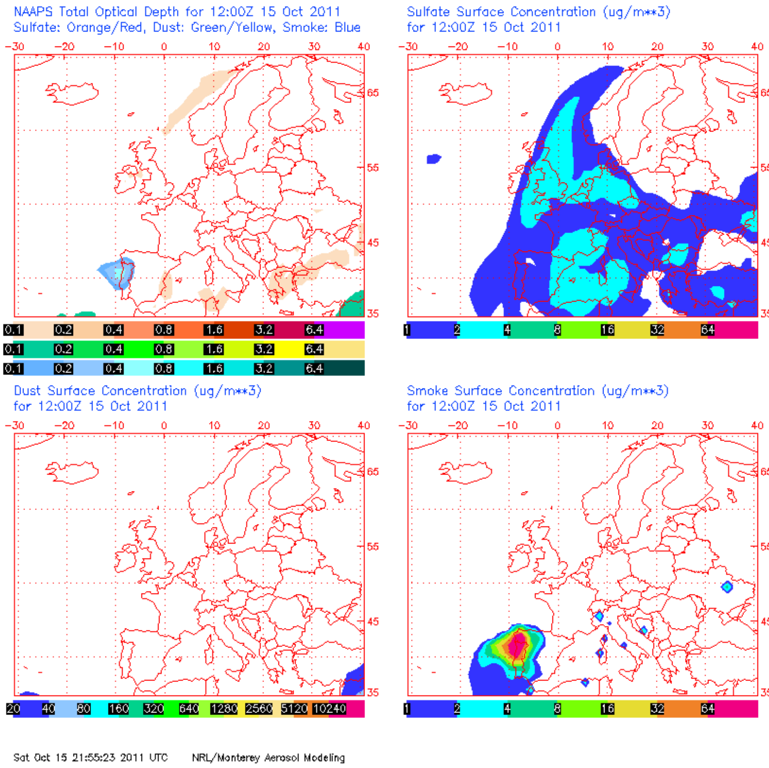


Fig. S10 Backward trajectories corresponding to 4 examples of different atmospheric episodes affecting the study area, (a) African dust outbreak, (b) European episode, (c) winter regional episode, and (d) wildfire event.

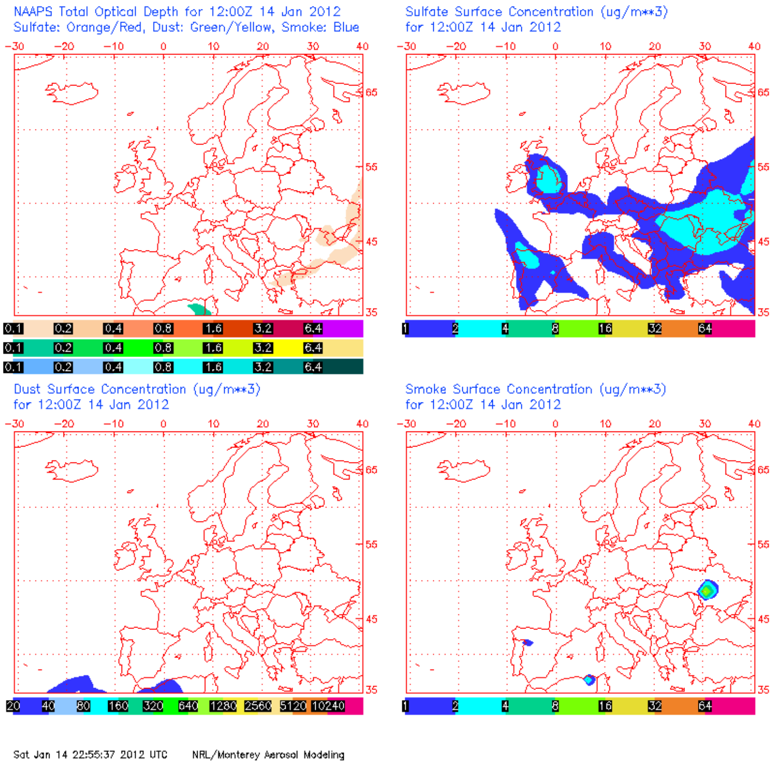
a) African dust outbreak (NAF)



b) European (EU) episode



c) Winter regional (WREG) episode



d) Wildfire event

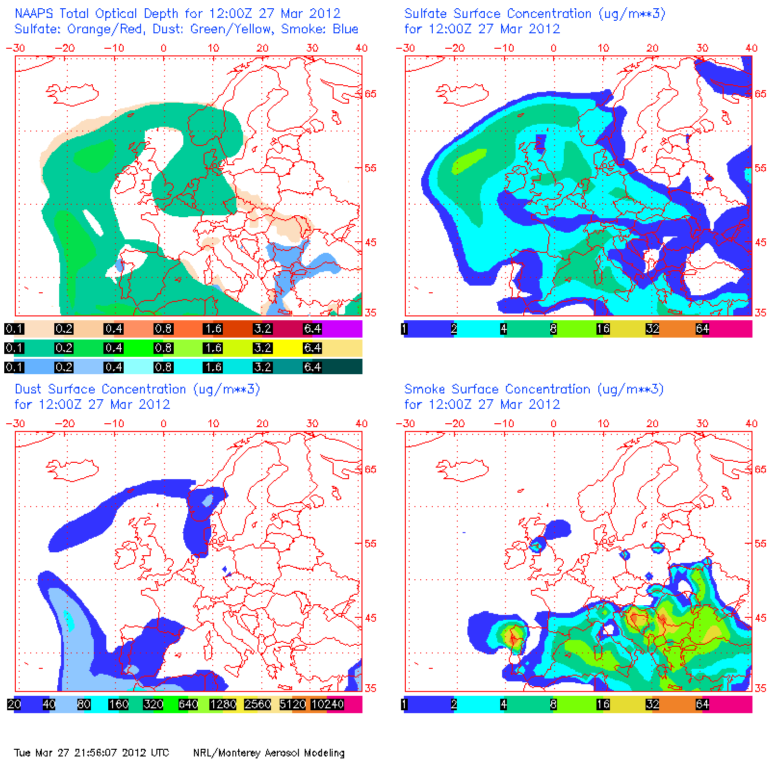


Fig. S11 Total optical depth, sulfate surface concentration, dust surface concentration, and smoke surface concentration from the NAAPS model corresponding to 4 examples of different atmospheric episodes affecting the study area, (a) African dust outbreak, (b) European episode, (c) winter regional episode, and (d) wildfire event.

Table S1 Average (and standard deviation for Montsec and Montseny) of PM_{10} and PM_1 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.s.l.)				Payerne (489 m a.s.l.)[2]	Magadino (200 m a.s.l.)[2]
	January 2010-March 2013		March 2011-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})	0.03	0.07	<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.