

Contribution of natural sources to PM emissions over the metropolitan areas of Athens and Thessaloniki

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Supplementary material

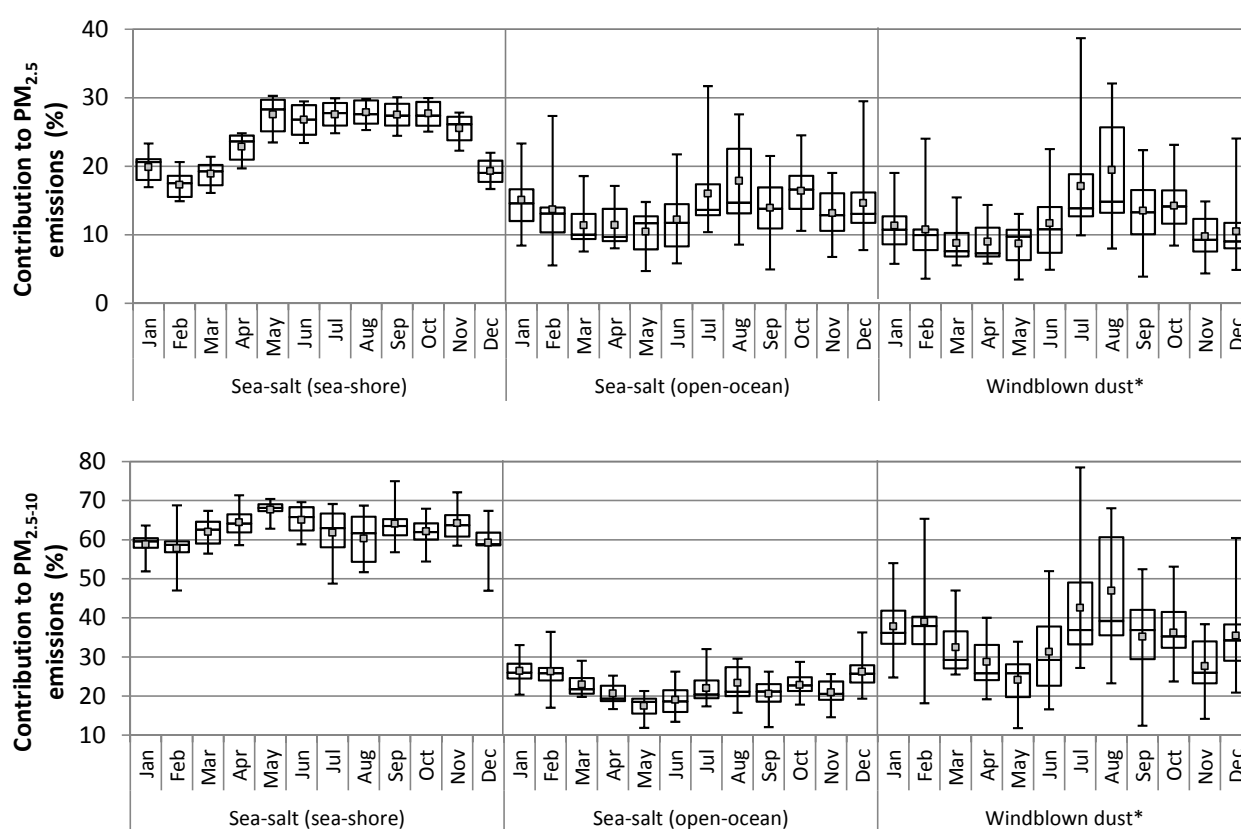


Fig. S1. Variation of monthly natural emissions contribution to (a) total primary PM_{2.5} emissions and (b) total primary PM_{2.5-10} emissions in AMA during the period 2000-2010 (*Values multiplied by 5).

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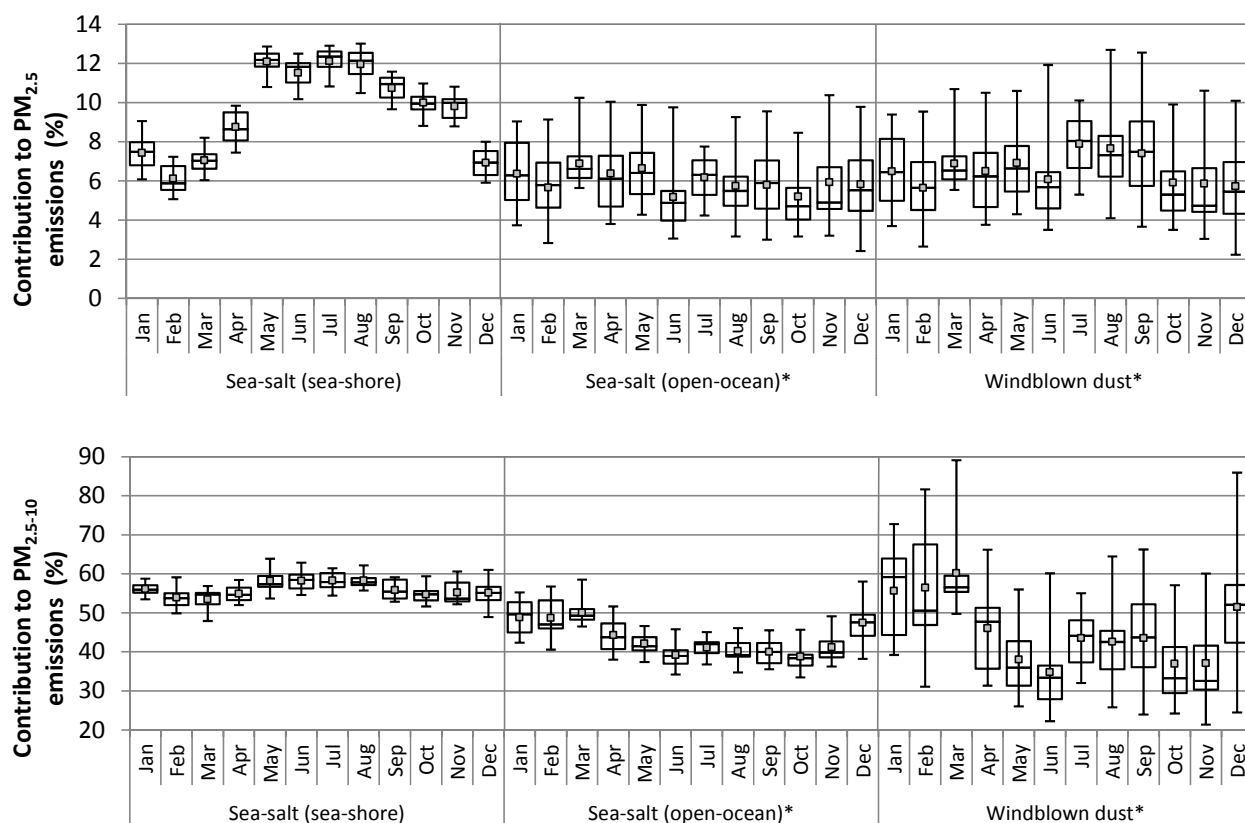


Fig. S2. Variation of monthly natural emissions contribution to (a) total primary PM_{2.5} emissions and (b) total primary PM_{2.5-10} emissions in TMA during the period 2000-2010 (* Values multiplied by 5).

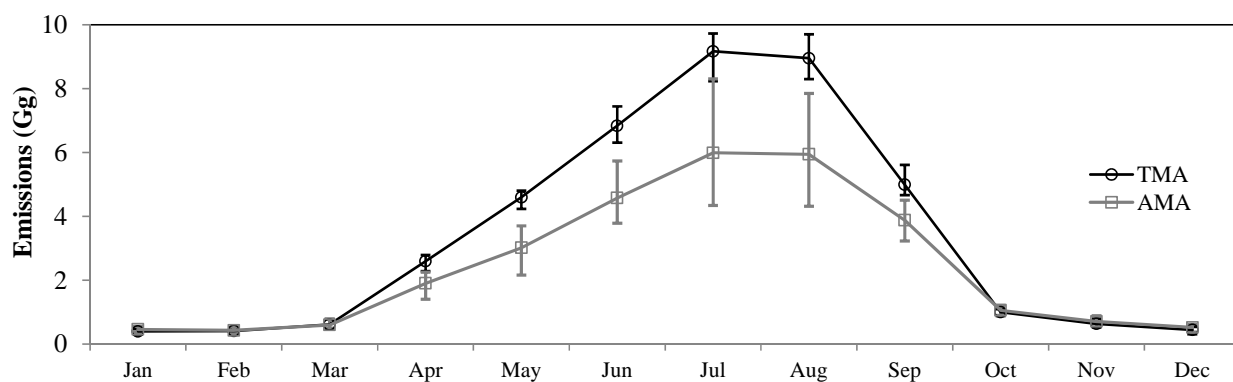


Fig. S3. Inter-annual monthly variation of BVOCs emissions in AMA and TMA for the period 2000-2010. Average, minimum and maximum monthly emission values are depicted.

Table S1 Comparison of emission sources and activity data in AMA and TMA for the year 2010

and % change compared to 2000 values (values retrieved from the EL.STAT.).

Parameter	AMA ^a		TMA ^b	
	2010	% change	2010	% change
Population (millions of inhabitants) ^c	3.83	-0.03	1.11	2
Electric energy consumption (thousand kwh)				
<i>Domestic</i> ^d	7349680	23	1864003	17
<i>Commercial</i>	5499426	37	150145	-86
<i>Industrial</i>	2617166	13	1325325	-23
<i>Agricultural</i>	72039	13	92860	-22
<i>Public and Municipal</i>	668163	26	167136	51
<i>Street lighting</i>	248596	26	69615	49
Number of Vehicles ^e				
<i>Passenger</i>	2756052	63	550844	61
<i>Trucks</i>	285817	19	101523	22
<i>Busses</i>	12733	1.2	2535	4.2
<i>Motorcycles</i>	669614	86	125852	87
Aircraft traffic				
<i>Departures - Arrivals</i>	181859		44938	
<i>Freight and mail (tons)</i>	96676		8902	
Coastal traffic (millions of passengers) ^f				
<i>Embarked</i>	5.00	31.6	0.06	-26
<i>Disembarked</i>	5.00	31.6	0.06	-19
Industry ^g	West Attica and Piraeus		Close to city centre	
Heating degree days (base temperature of 18°C) ^h	1253		1756	
Agriculture (thousands acres) ⁱ				
<i>Annual crops</i>	98	-27.4	1178	-5
<i>Vineyards</i>	50	-15.3	12	0
<i>Areas under trees</i>	249	-10.8	26	13
<i>Other areas</i>	73	9.0	190	850
Livestock (heads) ⁱ				
<i>Cattle</i>	4290	-31	67006	-5.9
<i>Sheep</i>	80156	-30	165286	-5.1
<i>Goats</i>	39517	-34	135130	-26
<i>Pigs</i>	6499	-64	11229	-28
<i>Horses, Mules, Asses</i>	239	-55	1016	232
<i>Rabbits</i>	18064	19	4860	32
<i>Poultry</i>	5140938	109	4959510	22
Construction (number) ^j				
<i>New built properties</i>	3740	-54	1343	-48
<i>Extension of built properties</i>	2307	-37	427	-27
Land distribution in each domain (km ²) ^k				
<i>Artificial</i>	640		243	
<i>Agricultural</i>	2103		4018	
<i>Forest and semi-natural</i>	2780		2294	

^a Values refer to Attica region; ^b Values refer to Thessaloniki prefecture; ^c Population census 2001 and 2011; ^d of which approximately 64% are used for space heating according to the survey on energy consumption in households conducted during the period 01/10/2011 to 30/09/2012 by the Hellenic statistical authority; ^e In Thessaloniki the absence of a contemporary public transportation system forces people to overuse private cars and consequently leads to high emission regimes in the urban sites of the city (Kassomenos et al. 2011).; ^f values refer to Piraeus and Thessaloniki ports; ^g E-PRTR database; ^h Papakostas et al. 2005; ⁱ Results of Agricultural-Livestock Census 1999-2000 and 2009; ^j rapid expansion of road network and of Athens urban area occurred mainly before the Athens 2004 Olympics (Fameli et al. 2013); ^k EEA Corine LandCover 2000

Table S2 Summary of emission sources, methodology and data used for the construction of the emission inventory of the period 2000 – 2010.

	Emission Source sector	Input data and notes	Spatial analysis and allocation
Anthropogenic	2. Non industrial combustion plants	1; 2; 3	Area based on population density
	3. Industrial combustion	1; 2; 4	Area over artificial surfaces; Point at source location
	5. Extraction and distribution of fossil fuels and geothermal energy	1; 2; 3; 4	Area over artificial surfaces based on population density
	6. Solvent and other product use	1; 2; 3	Area based on population density; Point at source location
	7. Road transport	1; 2; 3; Road network	Line over road network, based on population density
	8a. Other mobile sources and machinery	1; 2; 4	Area based on landcover
	9. Waste treatment and disposal	1; 2; 3; 4	Area based on landcover and population density
	10. Agriculture	Livestock number and distribution of agricultural area from the Hellenic Statistical Authority, Emission factors as in Aleksandropoulou et al. 2011; 1; 2; 4	Area over agricultural land; Point at source location
	8b. International ship emissions	1; 2; 4	Distributed over sea areas
	Large Point Source emissions from sectors 1 (Combustion in energy production and transformation industries), 3, 4 (Combustion in manufacturing industries), 5, 6, 9 and 10	E-PRTR data at LPS coordinates in tn/yr gap filled based on the Industrial production indicator and the procedure described in the European Union emission inventory report 1990-2008; data handling as in Aleksandropoulou et al. 2011; 2 (for sector 1 modified as in Simpson et al. 2012)	Point at source location
Natural	Biogenic emissions	Meteorological data from FOODSEC Meteodata distribution page and the Hellenic national meteorological service; 4; Soil texture from the European soil database; Vegetation species from FILOTIS database; Emission factors as in Aleksandropoulou et al. 2013; Temporal profile based on monthly meteorological data	Area estimated for each cell
	Sea salt from open ocean		
	Sea salt at sea shore		
	Windblown dust		

¹ UNCLRTAP/EMEP database; 50 × 50 km²; Mg/year

² temporal profile by GENEMIS

³ Population density map

⁴ Landcover map CLC 2000 v2009