CONTRIBUCIÓN DE FUENTES A PM_X URBANO

AIRUSE

LIFE 11 ENV/ES/000584

Xavier Querol, IDAEA-CSIC

THE AIRUSE PROJECT AIMS

- Characterizing similarities & differences in PM sources & contributions across S-EU (**5 cities)**
- Once the main sources of PM10 and PM2.5 are identified, the strategic goal of the AIRUSE project is **to develop, test and propose specific and non specific measures** to abate urban ambient air PM in S.-EU, **to meet AQ standards & to approach WHO guidelines**.

Specific PM mitigation measures

- Street washing & dust suppressants for road dust and deposited African dust
- Biomass burning
- Industrial emissions (channelled and fugitive)
- Strategies from other European countries (LEZ, eco-efficient vehicles, labelling, shipping, biomass burning…)

AIRUSE MANAGING STRUCTURE

idaea CSIC
Consejo Superior de Investigaciones Científicas

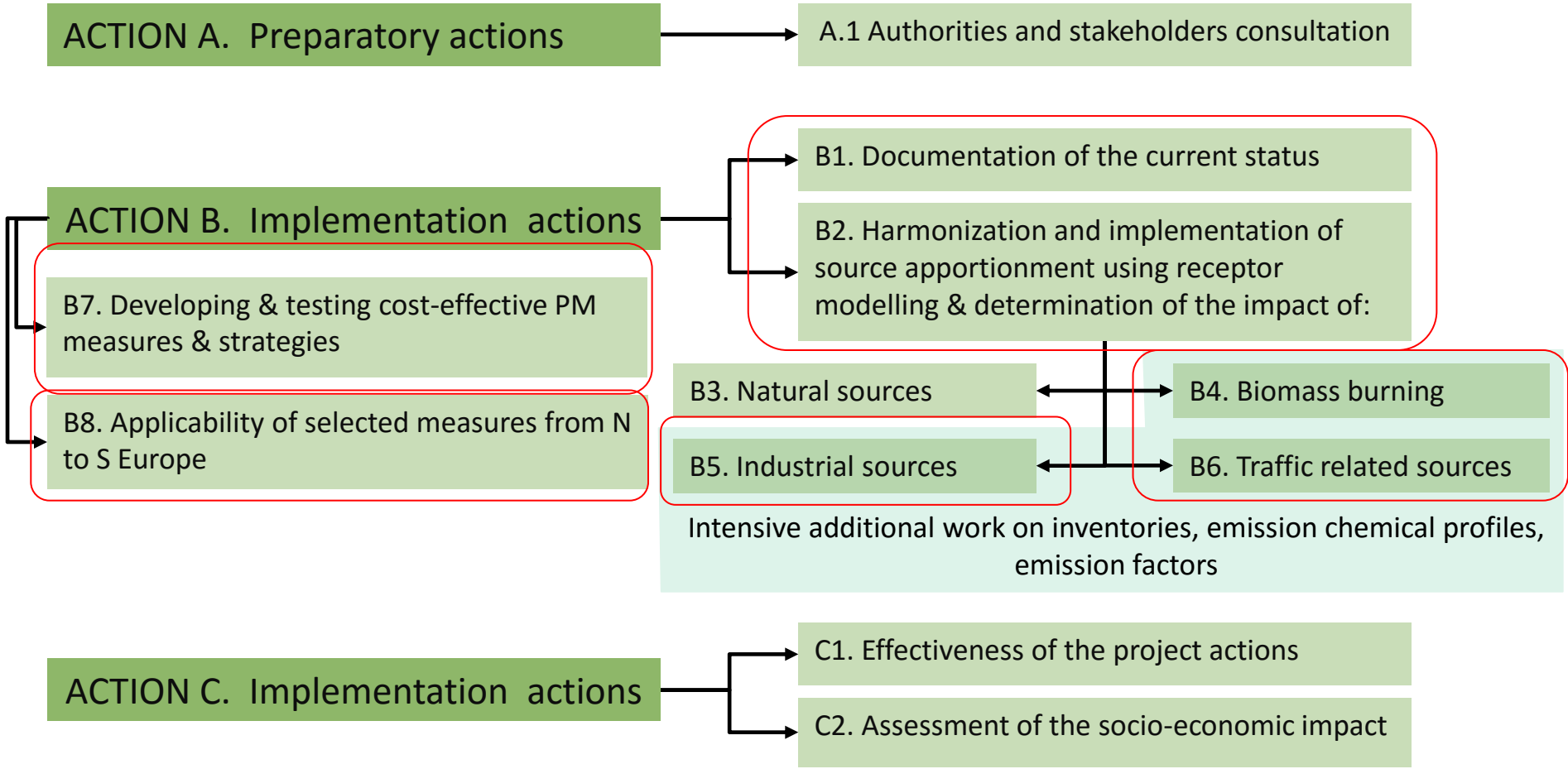
Coordinating Beneficiary

Project Manager
Spain

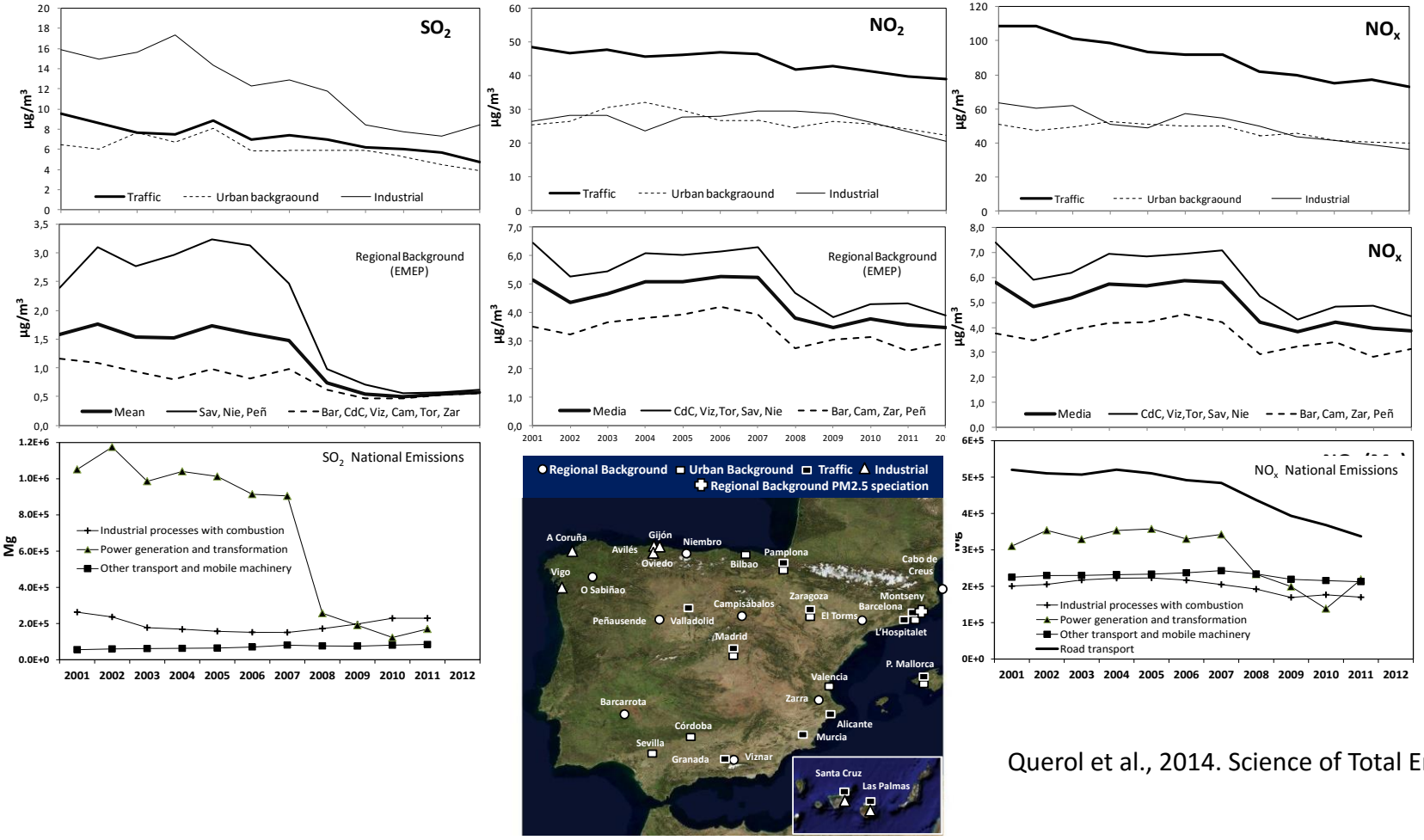
Associated Beneficiaries

Leader B5 D5	Leader B8	Leader B3 D2	Leader B2	Leader B4	Milan
Spain	UK	Greece	Italy	Portugal	Italy

AIRUSE STRUCTURE: ACTIONS & TASKS

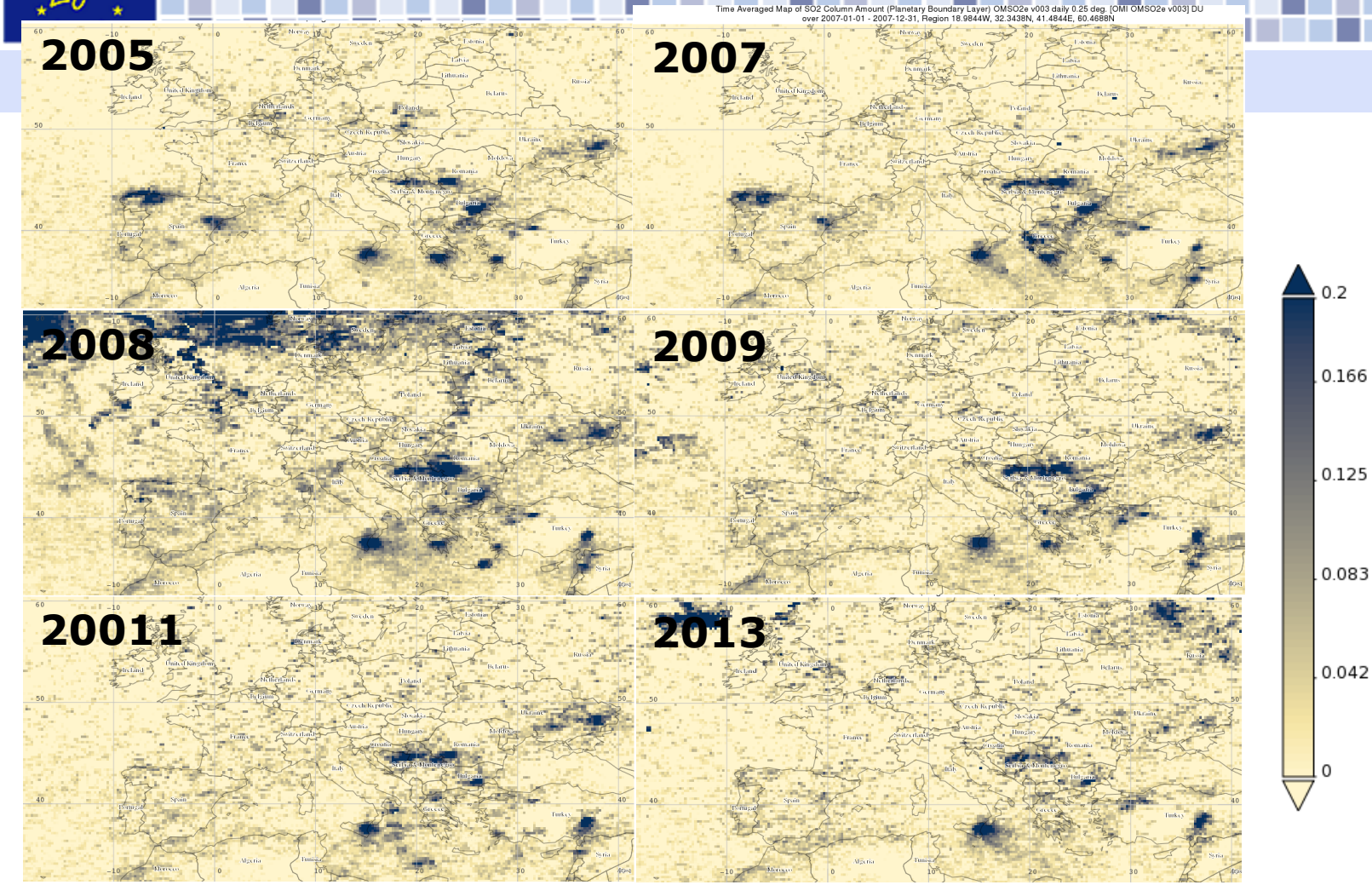


B1: AQ TRENDS SPAIN 2001-2012

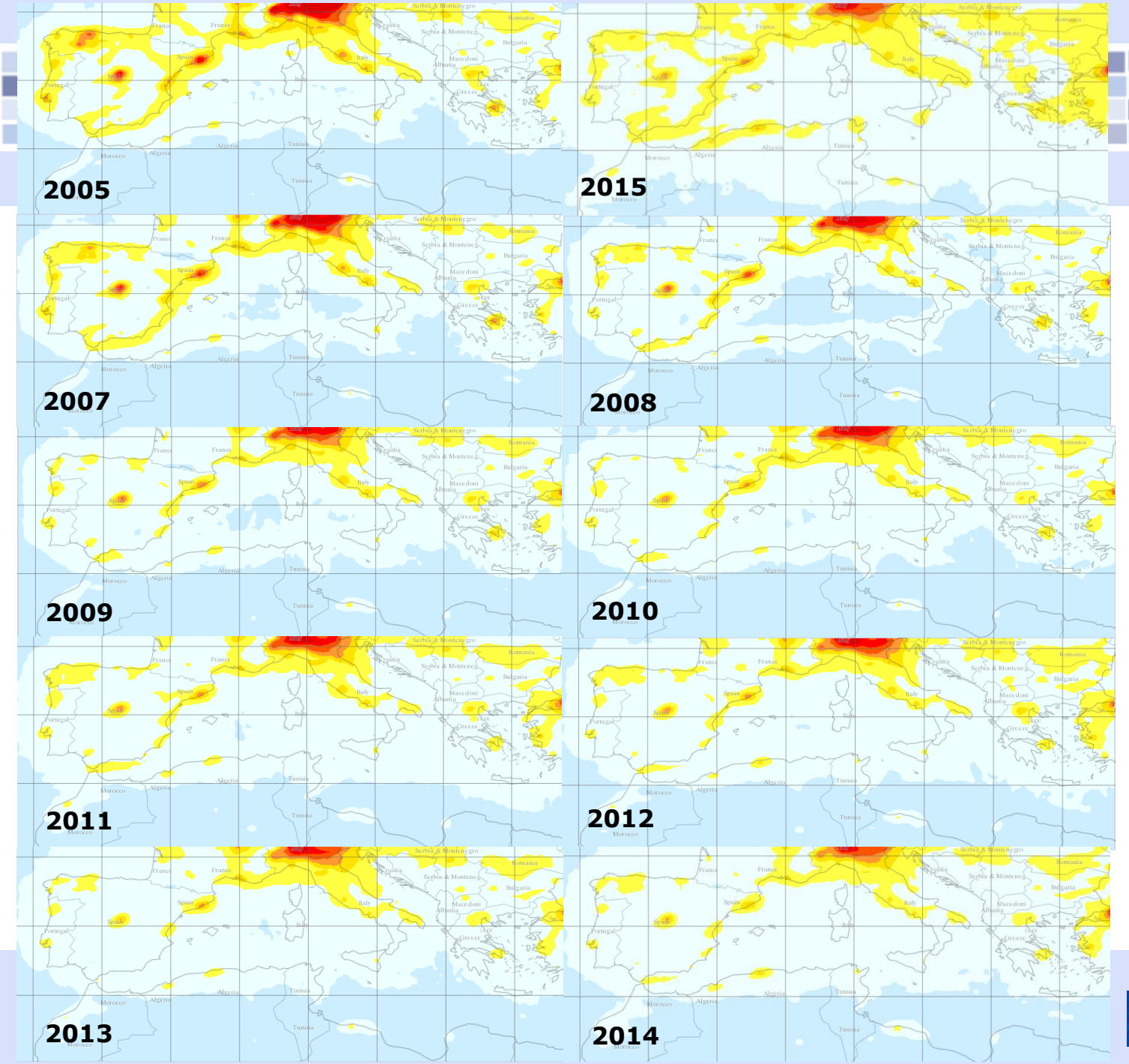


Querol et al., 2014. Science of Total Environment

Time average map of SO_2 Column amount (PBL) (Dobson Units)

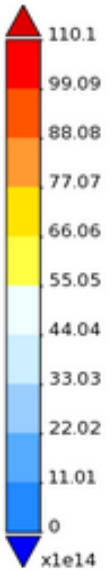


NASA SO_2 OMI level 3. Plotted using the Giovanni online data system, developed and maintained by the NASA GES DISC



NASA NO_2 OMI level 3
Plotted using the Giovanni online data system, developed and maintained by the NASA GES DISC

Mean annual tropospheric NO_2 column
(clear, 0-30% cloud)
(10^{14} molec/cm^2)



AIRUSE

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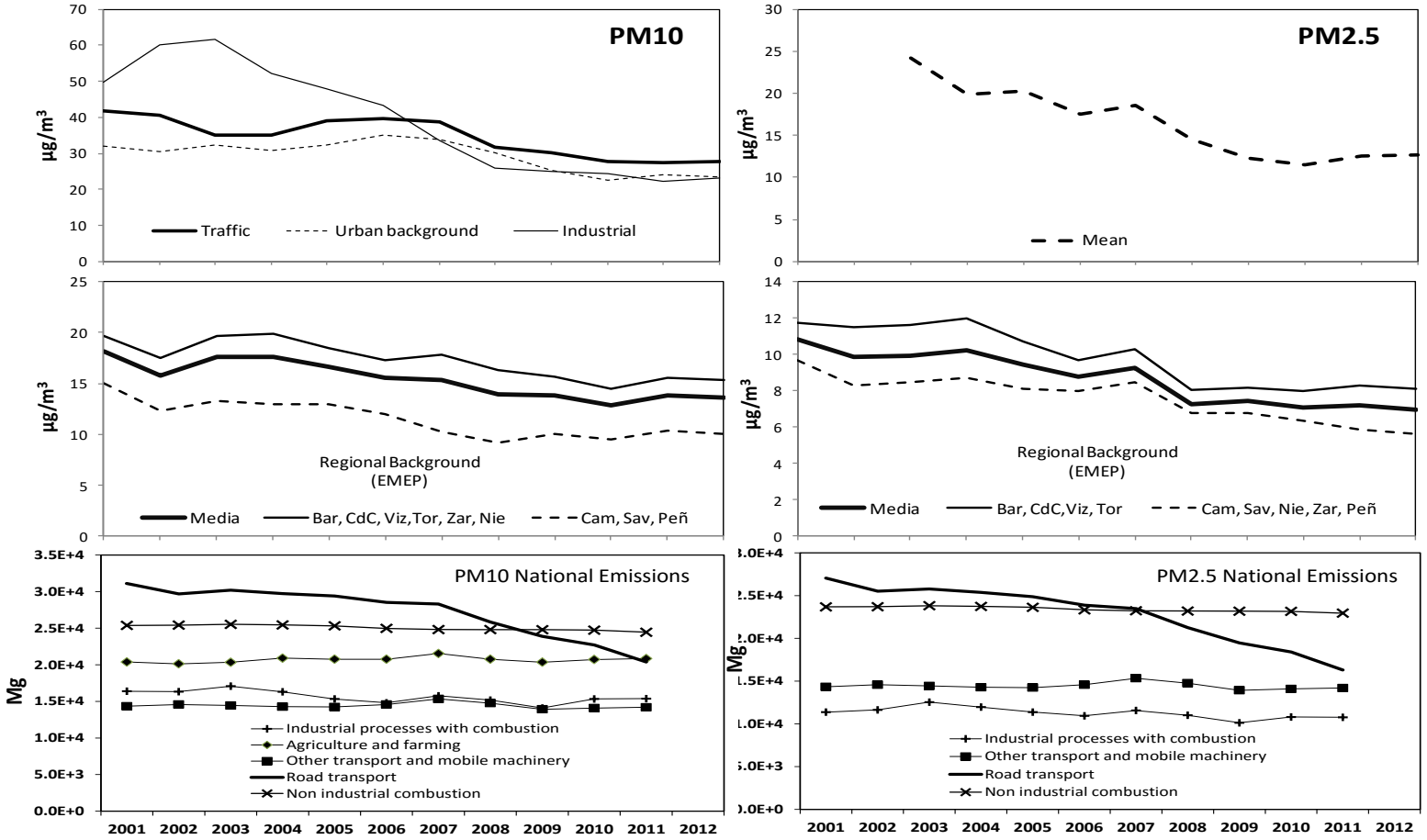
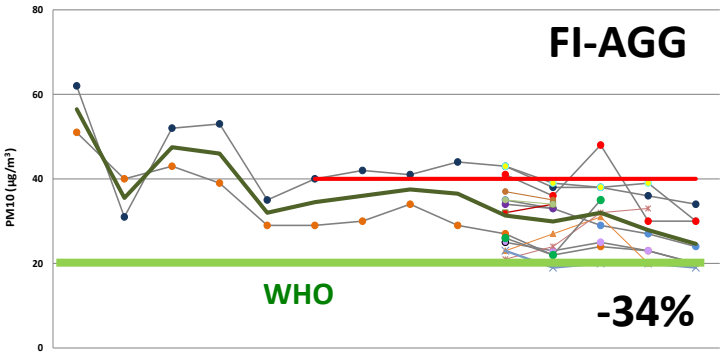
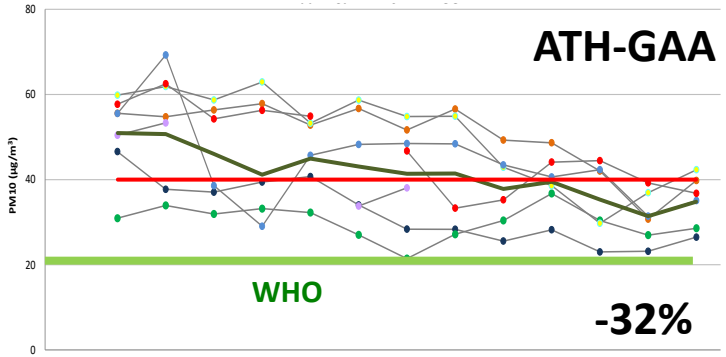
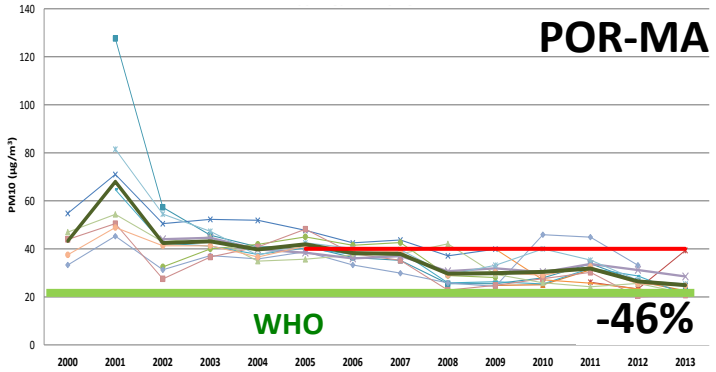


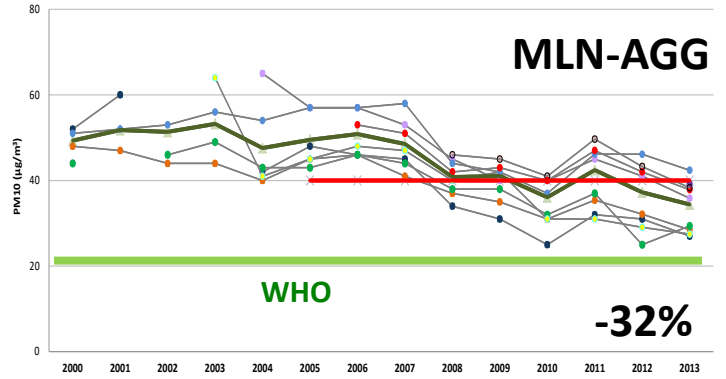
Querol et al., 2014. Science of Total Environment

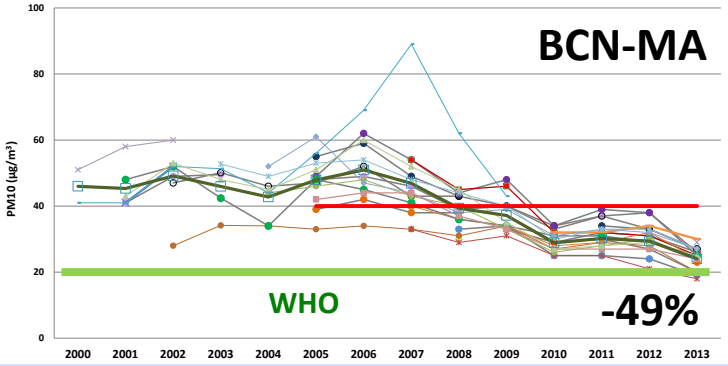
ANNUAL PM10 AVERAGES







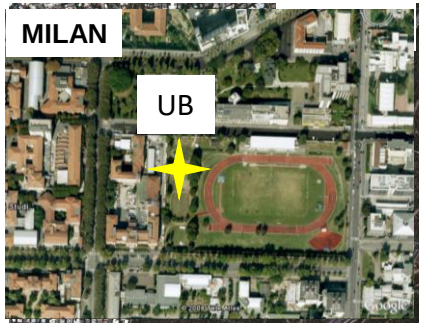


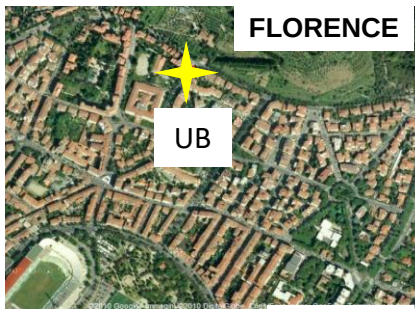


GENERALITAT VALENCIANA
CONSELLERIA D'AGRICULTURA, MEDI AMBIENT, CANVI CLIMÀTIC I DESENVOLUPAMENT RURAL

AIRUSE

B2. HARMONIZED 2013 PM10 & PM2.5 SOURCE APPORTIONMENT





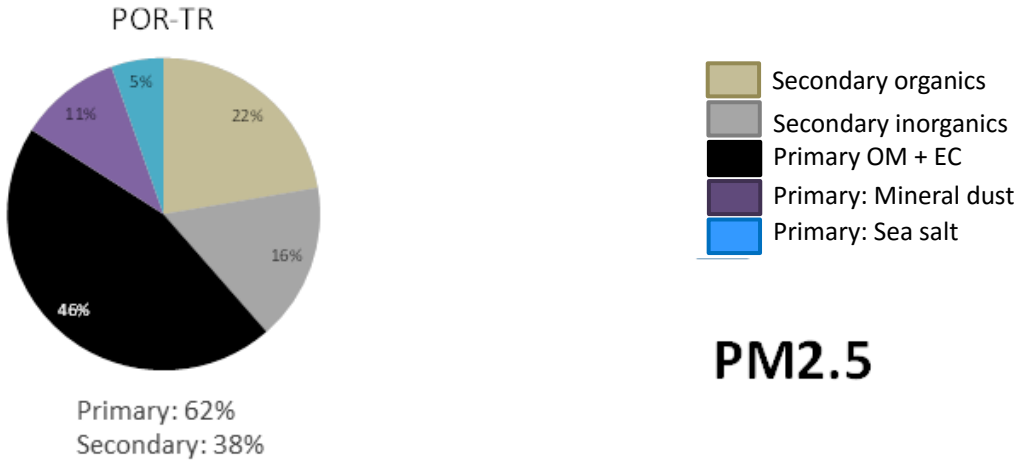
Long term measurements			BCN-UB	FI-UB	MLN-UB	POR-TR	ATH-SUB
Daily	PM10	**Mass**	122	226	379	123	197
		Elements	122	226	241§	123*	197‡
		Ions	122	226	337	123	197
		ECOC	122	226	348	123	197
		CC	122	226	89	123	197
		Levoglucosan			324		243
	PM2.5	**Mass**	126	243	378	126	243
		Elements	126	243	361§	126	243
		Ions	126	243	374	126	243
		ECOC	126	243	370	126	243
		Levoglucosan	126	243	356	126	888
Hourly	PM2.5-10	Elements	716	504		504	888
	PM2.5	Elements	714	504		504	197

*intercomparison between PIXE and ICP on Teflon filters
‡intercomparison between Teflon (PIXE) and quartz (ICP) filters
§ intercomparison between PIXE and XRF on Teflon and MCE filters

PIXE
ICP
SUNSET
XRF
Infrared
IC
GC

1047 PM10 samples
1116 PM2.5 samples

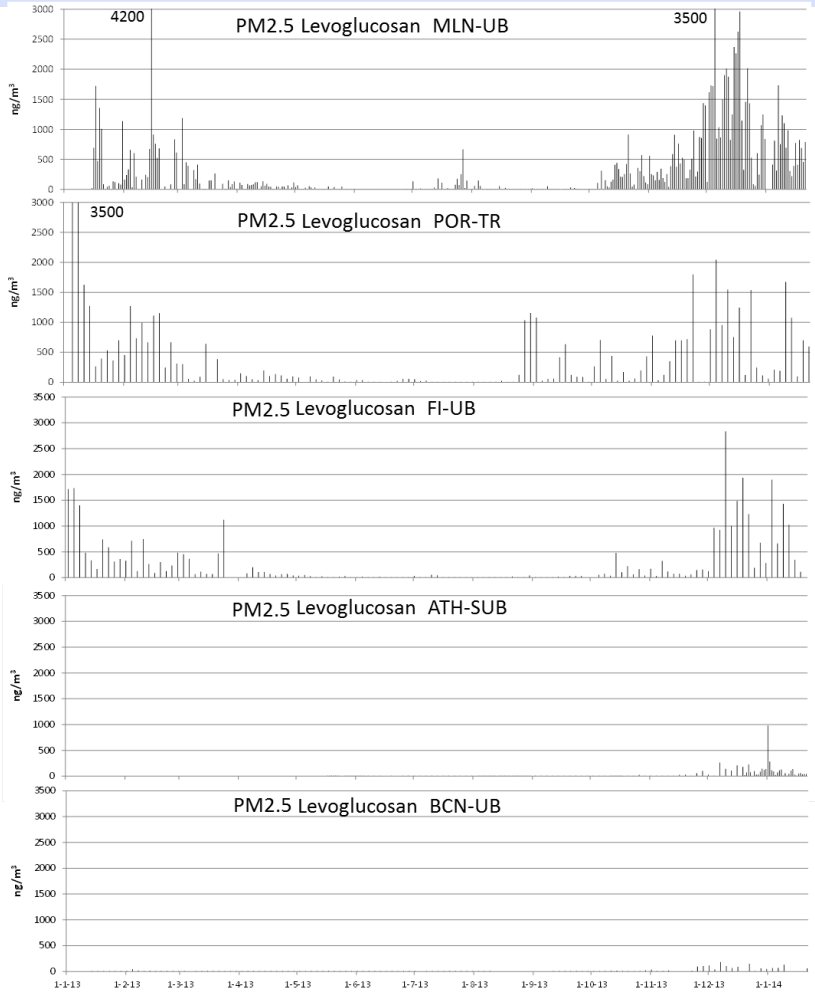
B2. HARMONIZATION & OBTENTION OF 2013 PM10 & PM2.5 SOURCE APPORTIONMENT

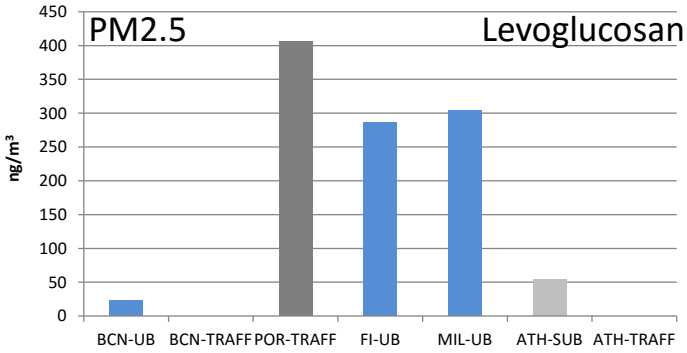


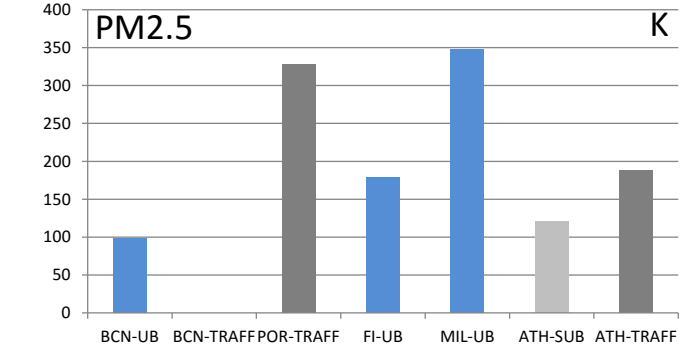
PM10 (annual mean)	**PM10** (days of exceedance)
1. **Road Traffic** is the main source contributing to PM10: **23-38%**	**24-45%**
1.1. Vehicle exhaust + traffic related NO_3^- are the main causes: **20-29%**	**30-34%**
1.2. Non-exhaust vehicle emissions are also relevant: **8-11%**	**18-29%**
2. **Regional OC and/or SO_4^{2-}** dominated pollution: **20-26%** (POR-TR 10%)	BCN-ATH **11-30%,** 2-6%
3. **Local dust** : **9-19%**	POR & ATH-SUB 13-**27%,** 1-4%
4. **Biomass burning** very relevant in POR & FI (**14-16%**), less in ATH (**12%**), negligible in BCN	POR,FI (**25-30%**),ATH-TR11%, <1 BCN,ATH-SUB
5. **Industry** BCN **11%, 4-5%,** ATH <1%	BCN **17%,** <1-3%
6. **Non traffic-NO_3^-** **6-12%** (2% POR)	BCN, FI 7-9%, 1-2% POR,ATH-SUB, 22% ATH-TR
7. **Shipping** **4-5%** in coastal sites	3-5% in coastal sites
8. **African dust** ATH-SUB **14%,** 1-5%	1%, ATH-SUB 25-**52%**, ATH-TR 5%
9. **Sea salt** POR **13%, 4-8%**	ATH-SUB **7%,** 1-3%
10. **Anthropogenic dust** (Local dust + Non exhaust) reaches **19-27%**	**11-33%**

PM2.5 (annual mean)	**PM2.5** (days of PM10 exceedance)
1. **Road Traffic** is the main source contributing to PM2.5: **22-39%**	**28-42%** (ATH-SUB 9%)
1.1. Vehicle exhaust + traffic related NO_3^- are the main causes: **11-34%**	**31-40%** (ATH 11-19%)
1.2. Non-exhaust vehicle emissions are also relevant: **5-9%** (BCN&FI 1-2%)	1-9%
2. **Regional OC and/or SO_4^{2-}** dominated pollution: **19-37%** (POR **13%**)	BCN-MLN-ATH **11-24%,** 2-6%
3. **Local dust**: POR **16%**, **2-6%**	POR **22%,** 1-2%, ATH-TR <1%
4. **Biomass burning** very relevant in MLN, FI & POR (**18-21%**), less in ATH (**11-19%**) , negligible in BCN	POR, FI <2%, MLN (**26-33%**), ATH-TR 16%
5. **Industry** **5-12%**, ATH <1%	BCN **18%,** <1-3%
6. **Non traffic-NO_3^-** **3-8%** (POR **1%**)	BCN, FI, ATH & MLN **6-9%** (1-3% POR)
7. **Shipping** **5-7%** in coastal sites	**3-10%** in coastal sites
8. **African dust:** ATH **2-6%,** <1%	ATH-SUB **45%**, ATH-TR 4%, 1%
9. **Sea salt** POR **5%,** <1-3%,	<1%-2%
10. **Anthropogenic dust** (Local dust + Non exhaust) reaches **10-21%**, BCN **7%**, FI **4%**	**POR** 15, 3-9%

B2. HARMONIZATION & OBTENTION OF 2013 PM10 & PM2.5 SOURCE APPORTIONMENT

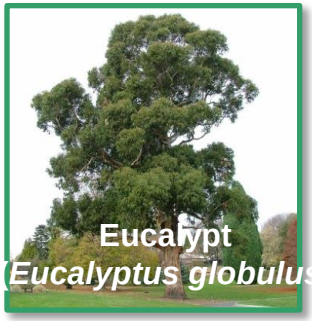




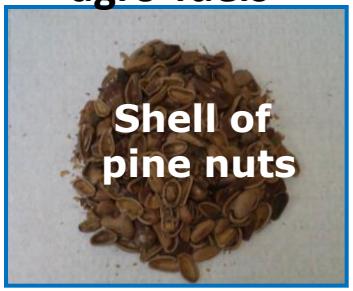


B4: BIOMASS BURNING PROFILES – BIOFUELS AND APPLIANCES

Biomass fuels: Based on forest inventories and information provided by the AIRUSE partners, wood species widely used as biofuels in residential combustion in Southern European



agro-fuels



Biomass burning appliances

1

Traditional brick fireplace

2

Traditional cast iron wood stove

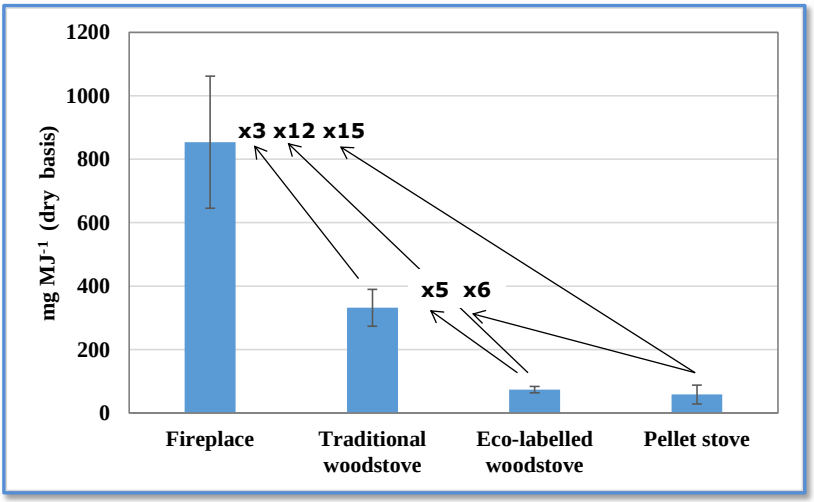
3

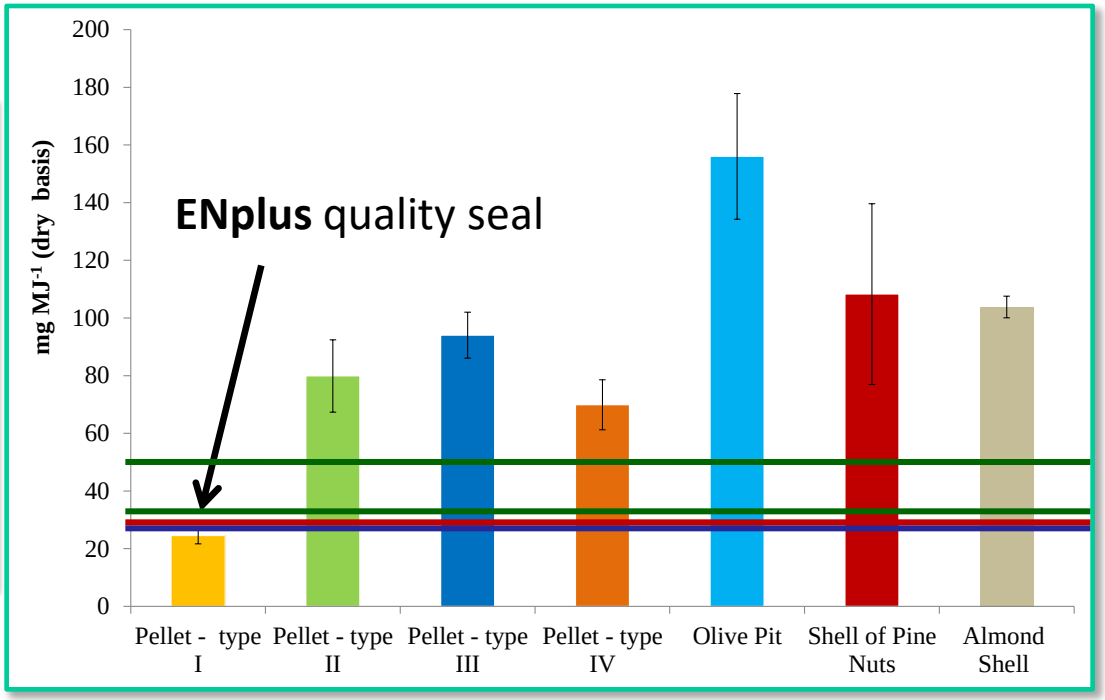
Eco-labelled chimney-type wood stove

4

Pellet stove

B4: PM EMISSION FACTORS



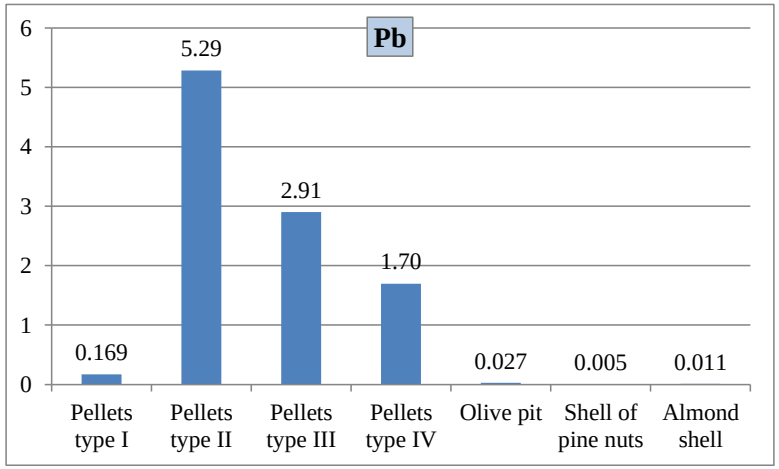


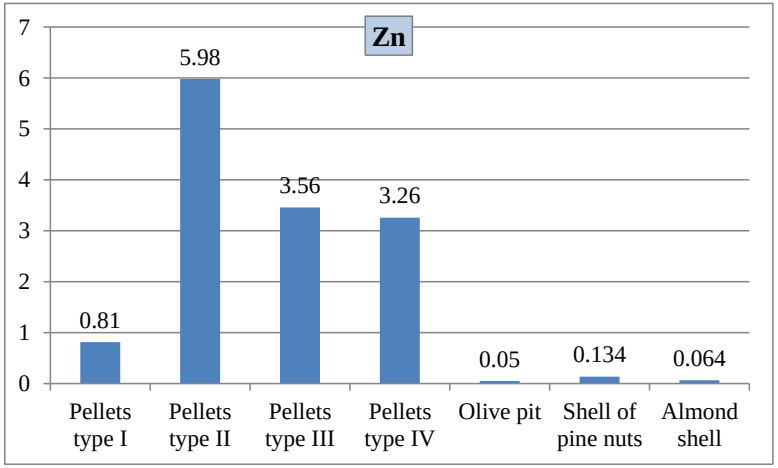
1 kg de biomasa corresponde aproximadamente a 18 MJ

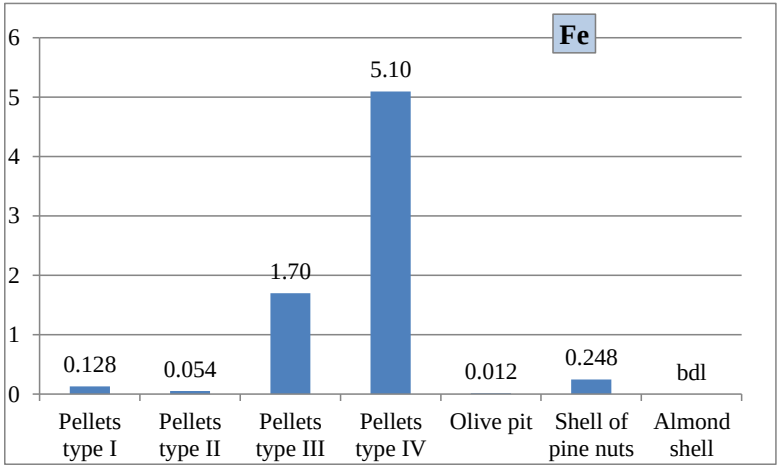
50 mg MJ^{-1} in Denmark & Switzerland
35 mg MJ^{-1} wood fuels & 25 mg MJ^{-1} for pellets in Austria
27 mg MJ^{-1} in Germany

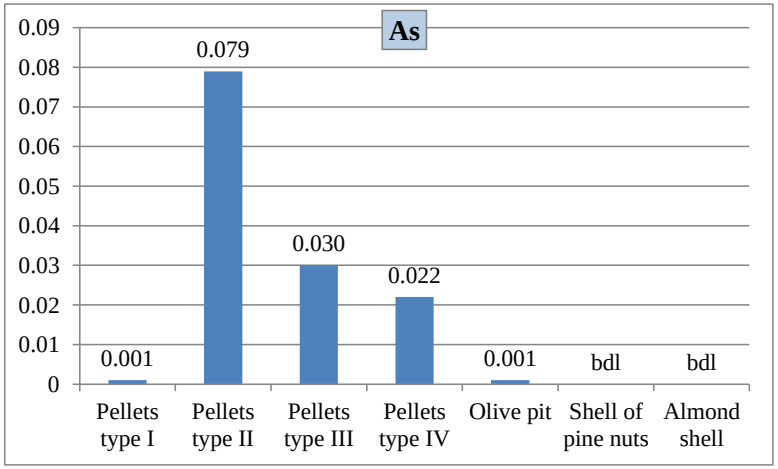
Standards need to be established in the EU for elemental composition of commercial wood pellets and chips to avoid the inclusion of extraneous materials. Only Germany has standards containing extensive trace element limits.

B4: PM10 MASS FRACTIONS OF TRACE ELEMENTS (wt%)









B4: RECOMMENDATIONS ON BIOMASS BURNING

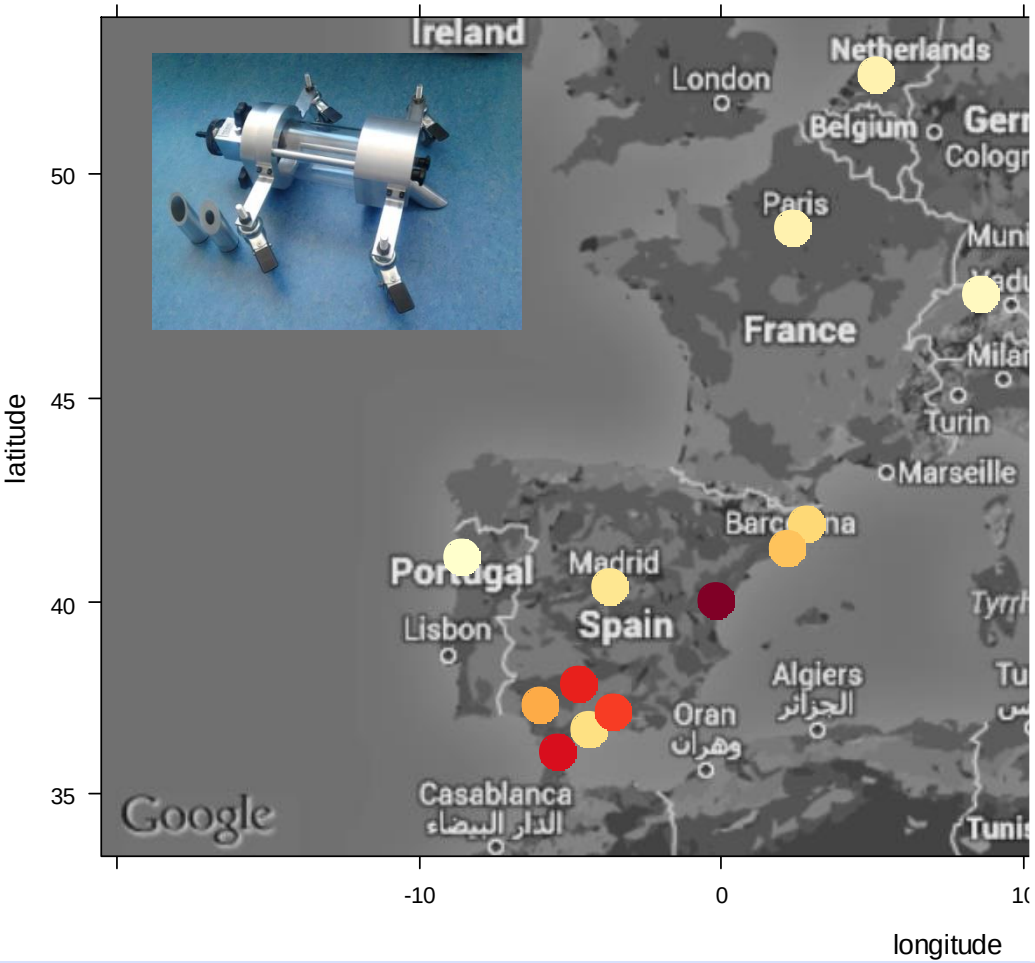
- Traditional residential combustion appliances, such as fireplaces and woodstoves, should be replaced by certified equipment rather than installing flue gas depollution technologies

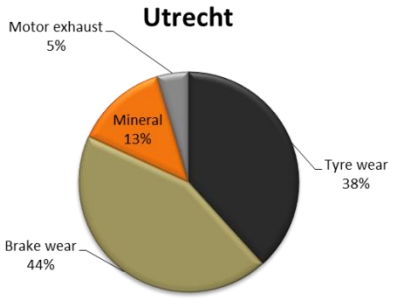
- Emission requirements for the eco-labelling or certification of small-scale combustion appliances must be mandatory in all countries

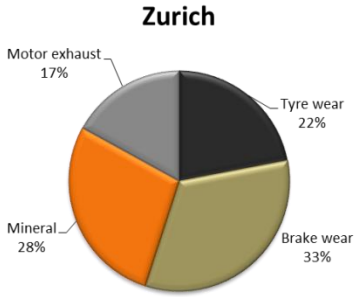
- The market of firewood sales should be regulated; chemically treated material should not be allowed in any quality class of pellets; all pellets sold at the market must have quality certification.

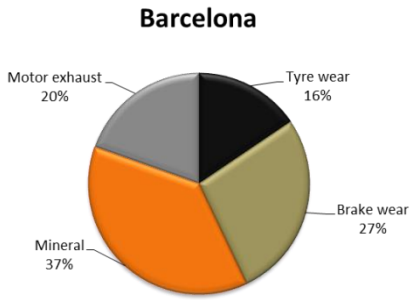
- Also transport and storage should be regulated to control moisture

B7: ROAD DUST LOADING IN EU









Road dust Loading mg/m^2

- Tyre wear
- Brake wear
- Mineral
- Motor exhaust

B7: REMEDIATION MEASURES

Preventive

- Reduce number of vehicles
- Reduce traffic speed
- Reduce HDV
- Reduce wear

Mitigation

- **Street washing (and sweeping)**
- **Calcium Magnesium Acetate (CMA)**
- **$MgCl_2$**
- **Polymers**
- $CaCl_2$
- Porous asphalt
- ….

B7: AIRUSE TESTS

Road dust

At **typical urban road**:

- Street cleaning
- CMA
- $MgCl_2$

At **industrial paved road**:

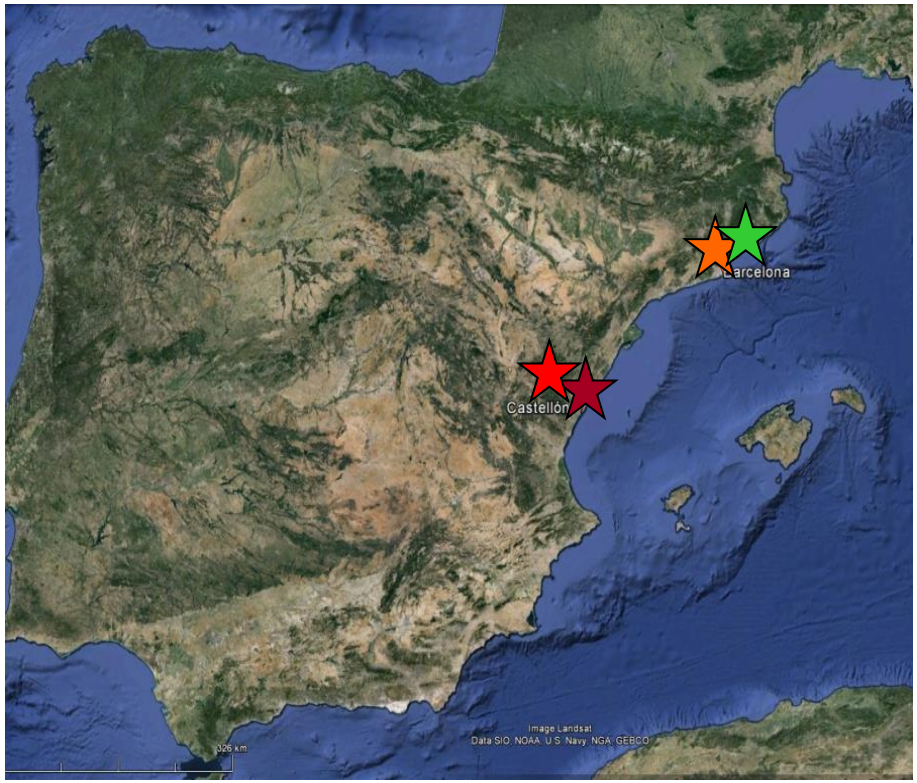
- Street cleaning
- CMA

At **unpaved road**:

- Water flushing
- CMA

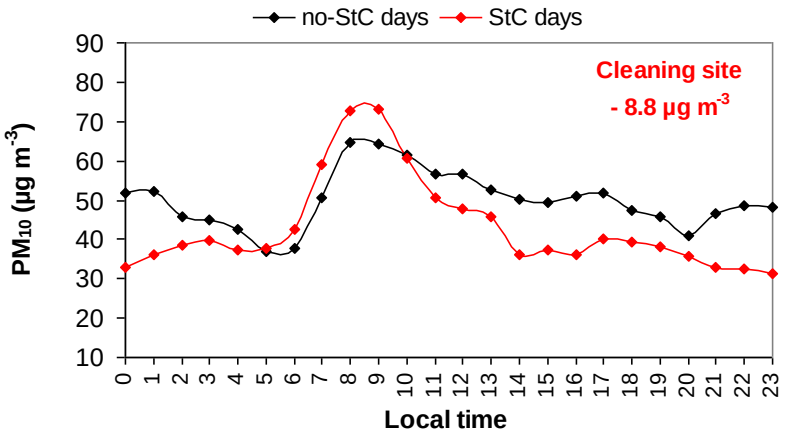
Soil dust

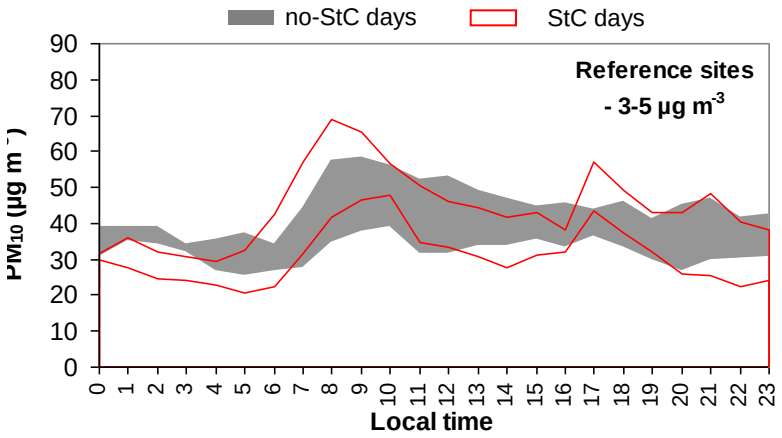
At **urban park** we tested nano-polymer



B7: URBAN ROAD (BARCELONA): STREET CLEANING







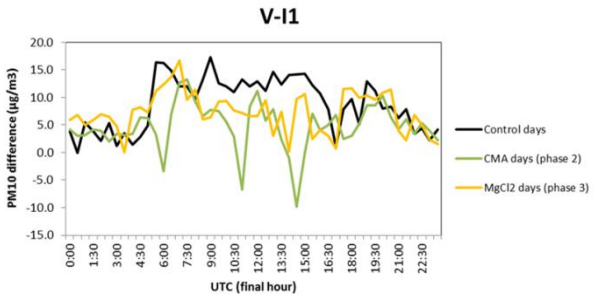
Reduction: 4-5 µg m^{-3} (7-10%)

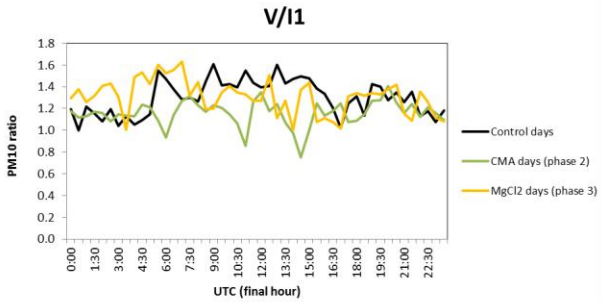
B:7 URBAN ROAD (BARCELONA)

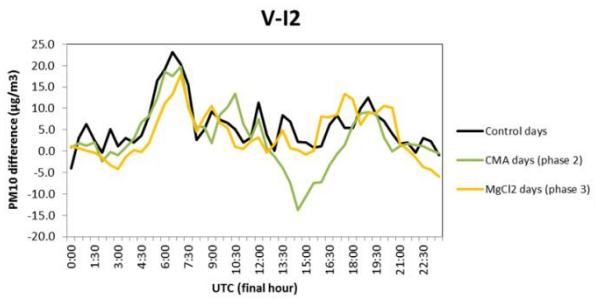
Water flushing: 1L H_2O/m^2 Dust suppressant: 20 g/m^2 of a solution 25%CMA or 20% $MgCl_2$

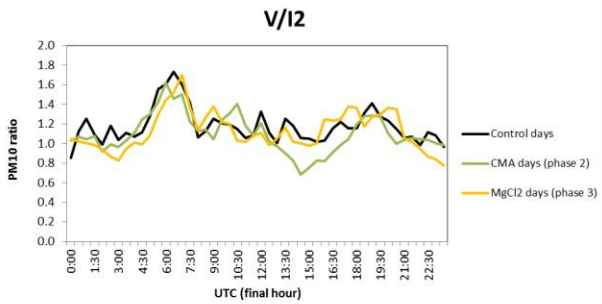
- Dust Track, TEOM and GRIMM;
- High volume samplers PM10 (daily)
- High volume samplers PM2.5 (every third day).
- PM chemical characterization (ions, elements, OC and EC);
- Streaker for PM2.5 and PM2.5-10;
- Black Carbon (MAAP and mini-aeth);
- NOx, O_3 and SO_2 and meteo.

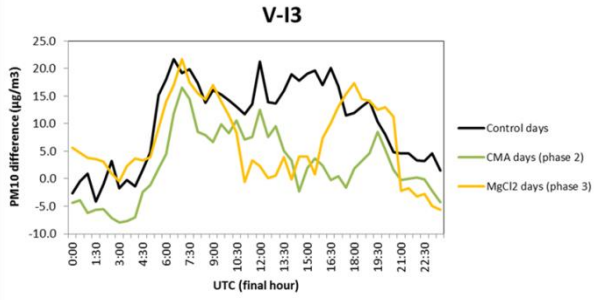
B7: URBAN ROAD (BARCELONA): CMA and $MgCl_2$

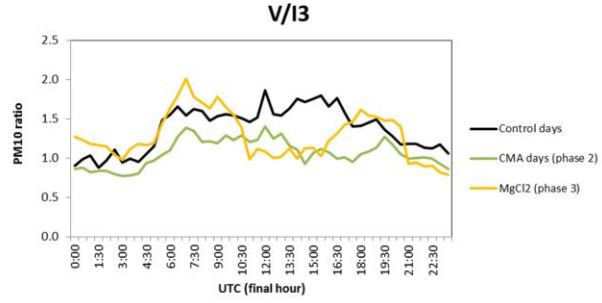




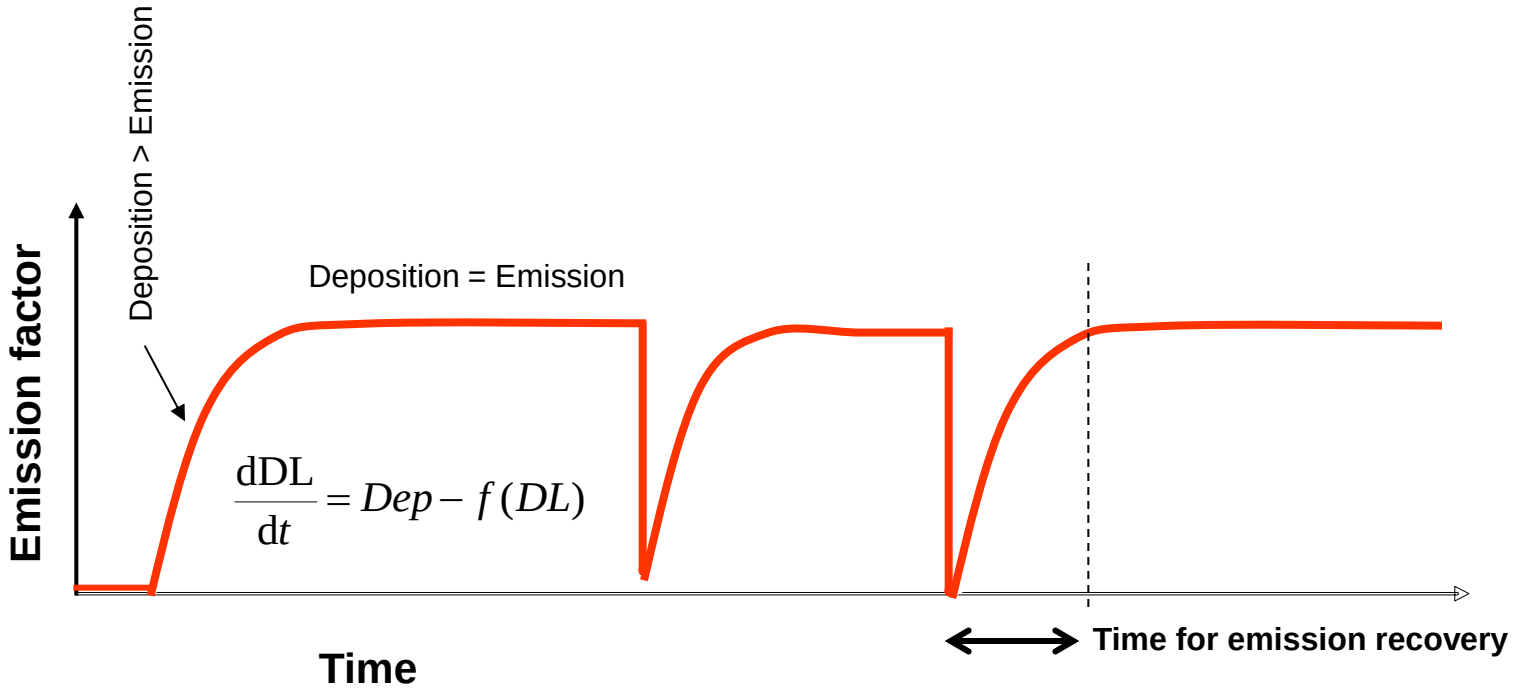








B7: EFFECT OF PRECIPITATION/WASHING



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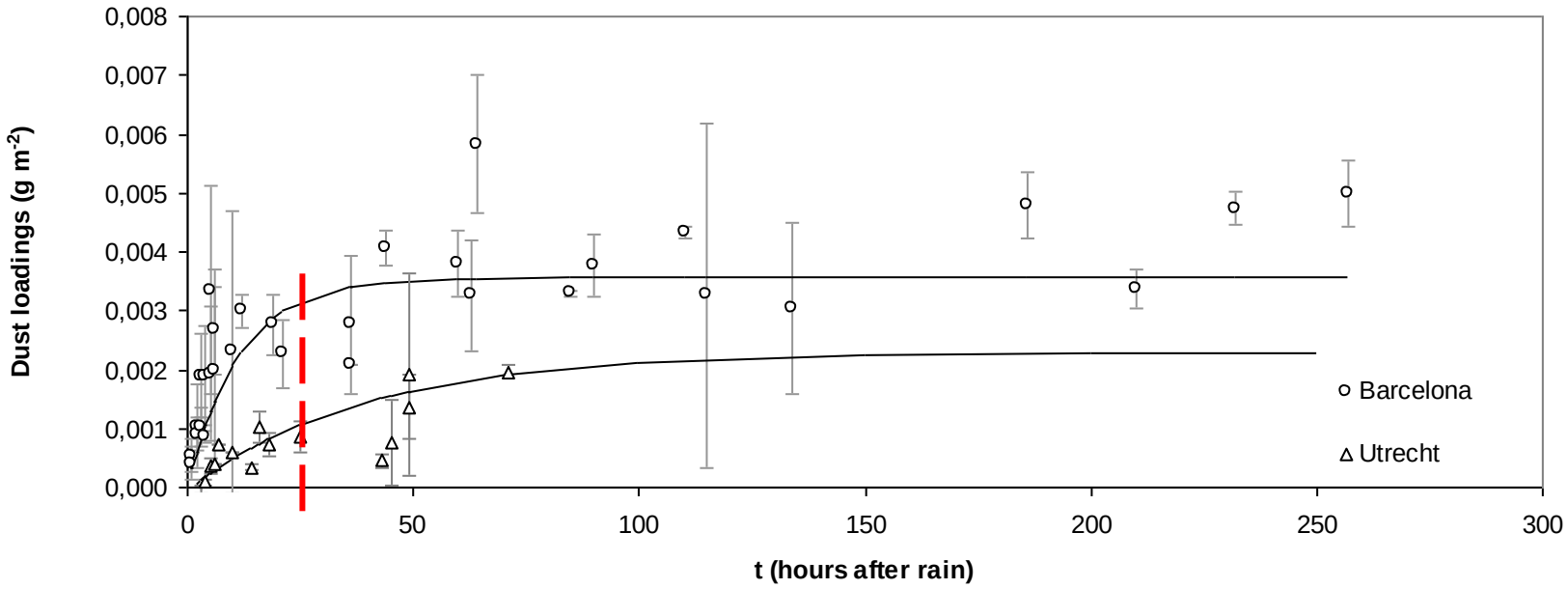

Barcelona

In 8 hours, 50% of dust is re-plenished
In 24 hours, 99% of dust is re-plenished

Utrecht

In 24 hours, 50% of dust is re-plenished
In 72 hours, 99% of dust is re-plenished

B7: RECOMMENDATIONS ON ROAD DUST ABATEMENT

Source	Location	Dust loading	Measure	Dosage	PM10 reduction	Notes on measurement
Road dust	Urban paved road	3-6 mg/m^2	Street washing	1 L/m^2	**7-10% on a daily mean**	kerbside
			CMA	15-20 g/m^2	Negligible	kerbside
			$MgCl_2$	15-20 g/m^2	Negligible	kerbside
	Industrial paved road	20-40 mg/m^2	Street washing	27 L/m^2	**18% on a daily mean**	kerbside
			CMA	30-60 g/m^2	**8% on a daily mean**	kerbside
	Industrial unpaved road	infinite	Street washing	3.5 L/m^2	**>90% up to 1 h**	downwind
			CMA	100 g/m^2	Not observed	downwind
Soil dust	Public park	infinite	Nano-polymer	3 L/m^2	**-2.9 µg/m³**	Inside the park

REPORTS PRODUCED (OR TO BE PRODUCED)

AIRUSE Summary Report

Action B1

01_Trends on air quality in Spain

02_Air pollutant trends in Barcelona

03_PM10 trends in the AIRUSE cities

Action B2

04_PM speciation and source apportionment

05_Chemical profiles of emission sources

06_Updated PM database for Southern Europe

Action B3

07_Contribution of natural sources to pm concentration levels

Action B4

08_Biomass burning in Southern Europe

09_Emission factors for biomass burning

Action B5

10_Industrial activities inventory in AIRUSE cities

11_PM industrial emissions quantification in AIRUSE cities

Action B6

12_Report on traffic sources contribution

Action B7

13_Report on mitigation measures in Southern Europe

http://airuse.eu/en/outreach-dissemination/reports/

Action **B8**

- **Street cleaning**
- **Dust suppressants**
- **Low emission zones**
- **Electric, hybrid and gas vehicles**
- **Diesel car/fuel taxation**
- **Vehicle Eco-efficiency**
- **NOx reduction technologies applied to traffic**
- **Biomass burning abatement in Northern Europe**
- **Shipping abatement measures**
- **Interference and synergy of air quality and climate**

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