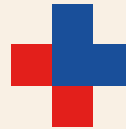




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Health effects of industrial pollution among people living in the area of Civitavecchia (Italy)

Carla Ancona

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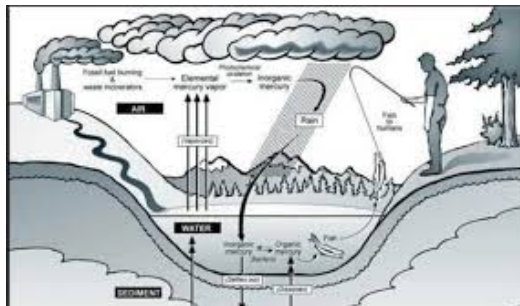
**IEHIA of Air Pollution and Climate Change in Mediterranean Areas
Trieste, 23-27 Aprile 2018**



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Epidemiological studies in industrial areas and contaminated sites

- ✓ Multiple sources
- ✓ Different pathways
- ✓ Variable time of contamination



- ✓ Population size (and size of the exposed groups)
- ✓ Socioeconomic status (environmental justice)

- ✓ Occupational exposure



- ✓ Outcomes definition and data collection
- ✓ Environmental worries and media pressure

Civitavecchia



thermoelectric power plants



Coal



Gas/Oil



Coal/Oil

Cement factory



harbor



traffic



Coastal deposits oil



biomass heating



- Civitavecchia
- Rome

Background

Epidemiological studies carried out in the Civitavecchia district showed high mortality and morbidity risk for lung cancer, mesothelioma and respiratory diseases both among workers and general population.

- Harbor workers (Bonassi 1985)
- Electric power plant workers (Forastiere 1989)
- Seamen and ship workers (Rapiti 1992)
- Respiratory diseases in children (Forastiere 1992, 1994)
- Lung cancer case-control study (Fano, 2004)

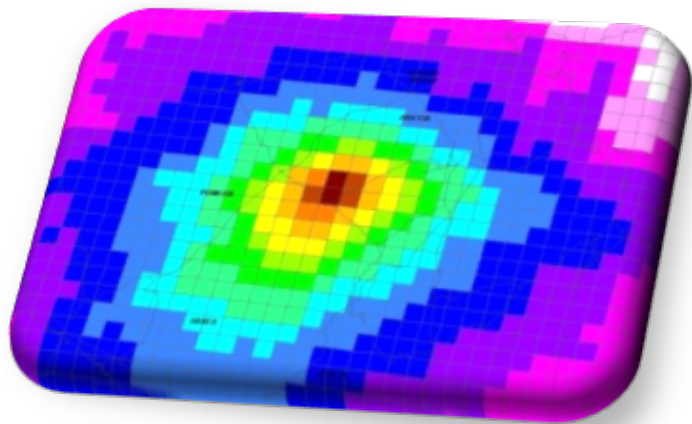
**data about individual
exposure to pollutants
from the different sources
were not available**



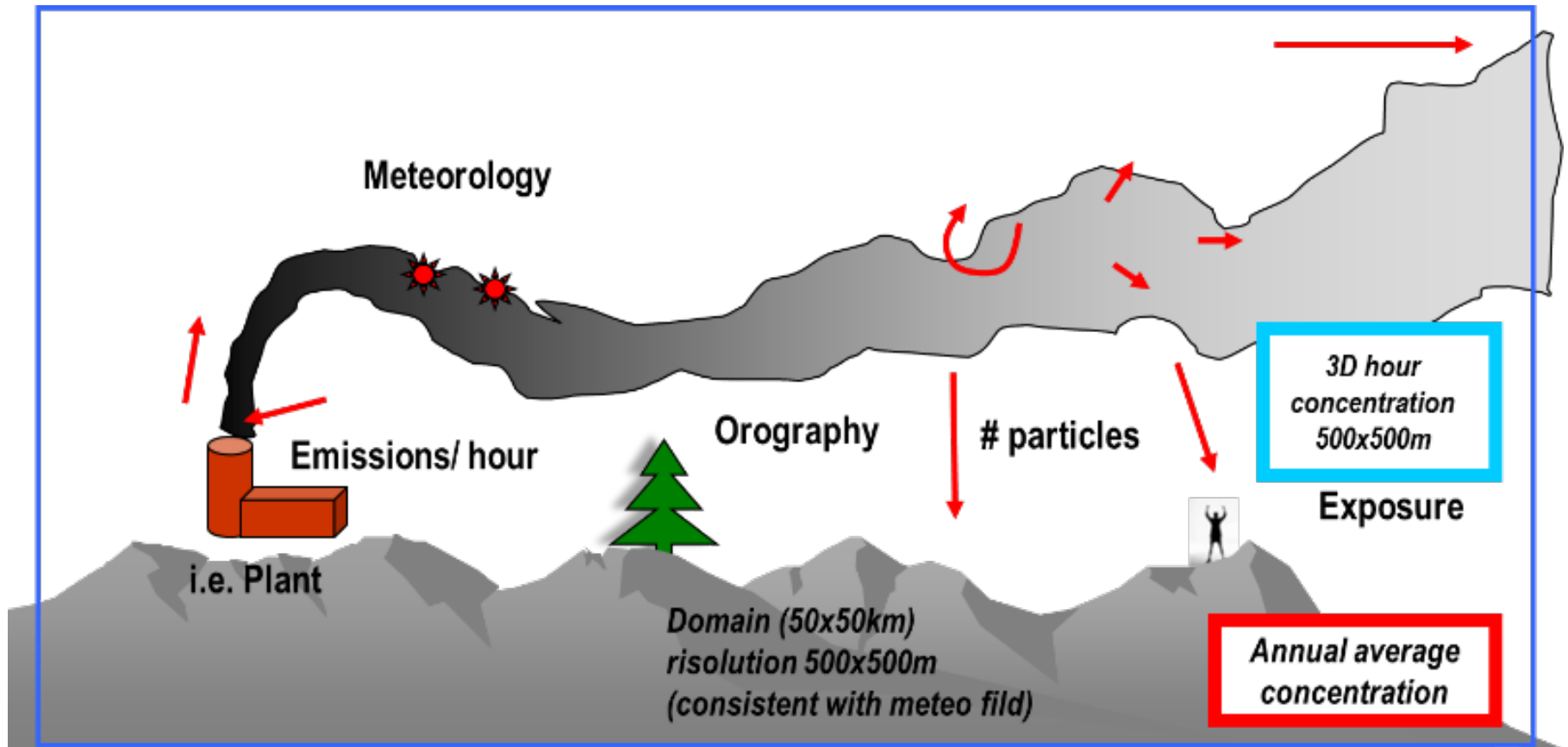
dispersion models

VS

HBM



Dispersion model



Metodi: Indicatori di esposizione

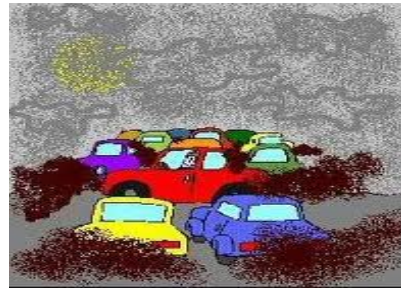
PM₁₀

coal power plant



NO_x

Traffic (cars +trucks)



PM₁₀

Harbor

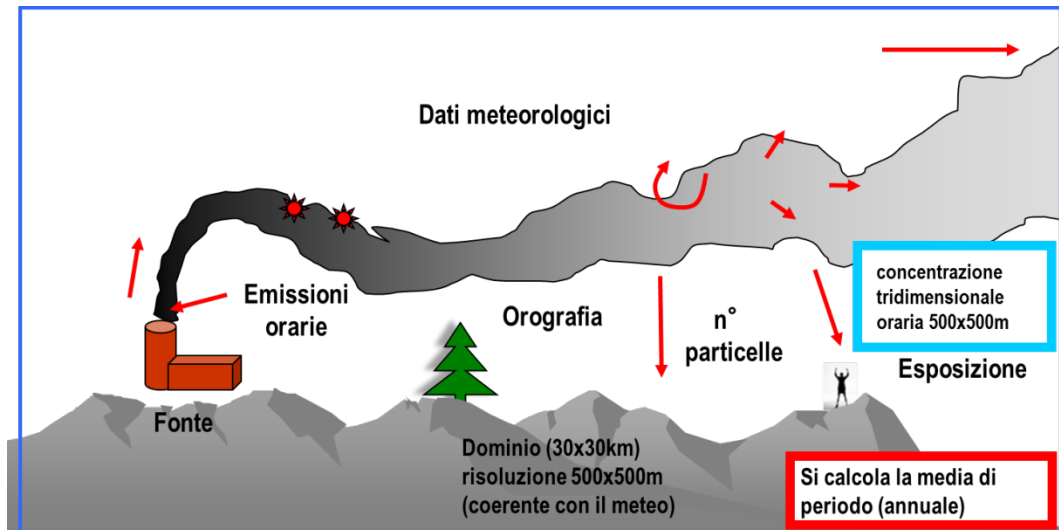


PM₁₀

biomass burning



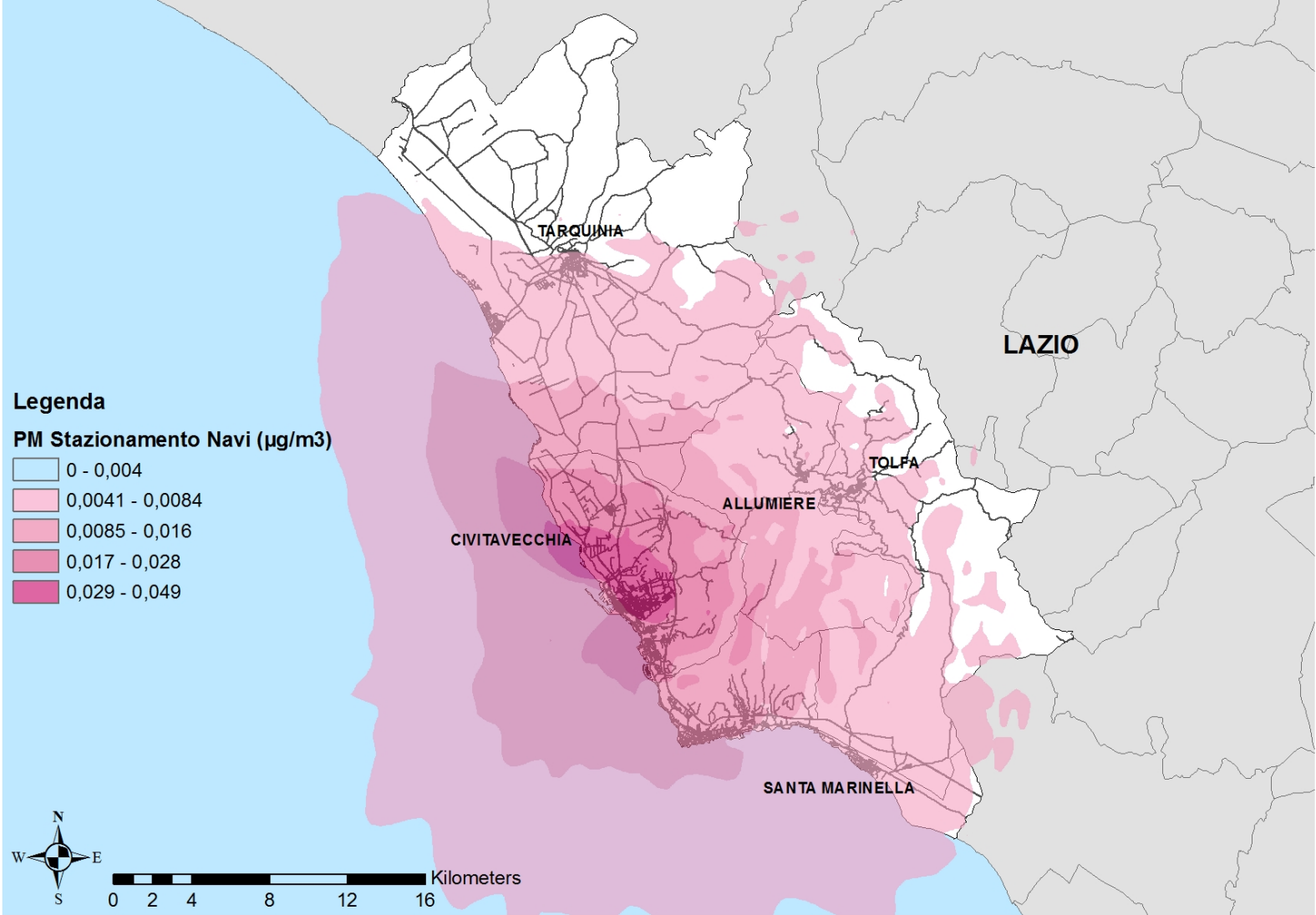
Lagrangian model SPRAY



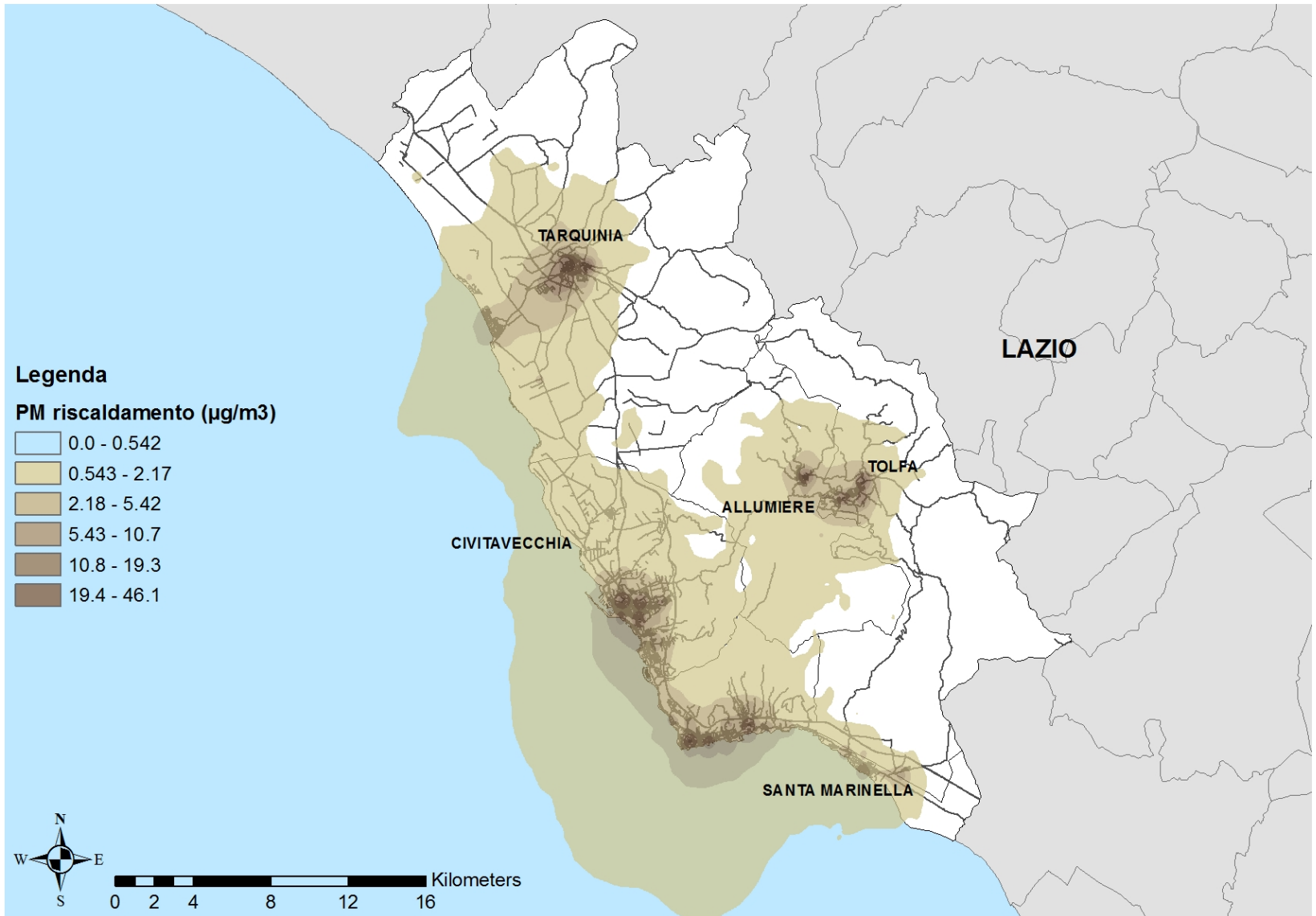
Coal power plant– PM Emissioni Autorizzate 2012 $\mu\text{g}/\text{m}^3$



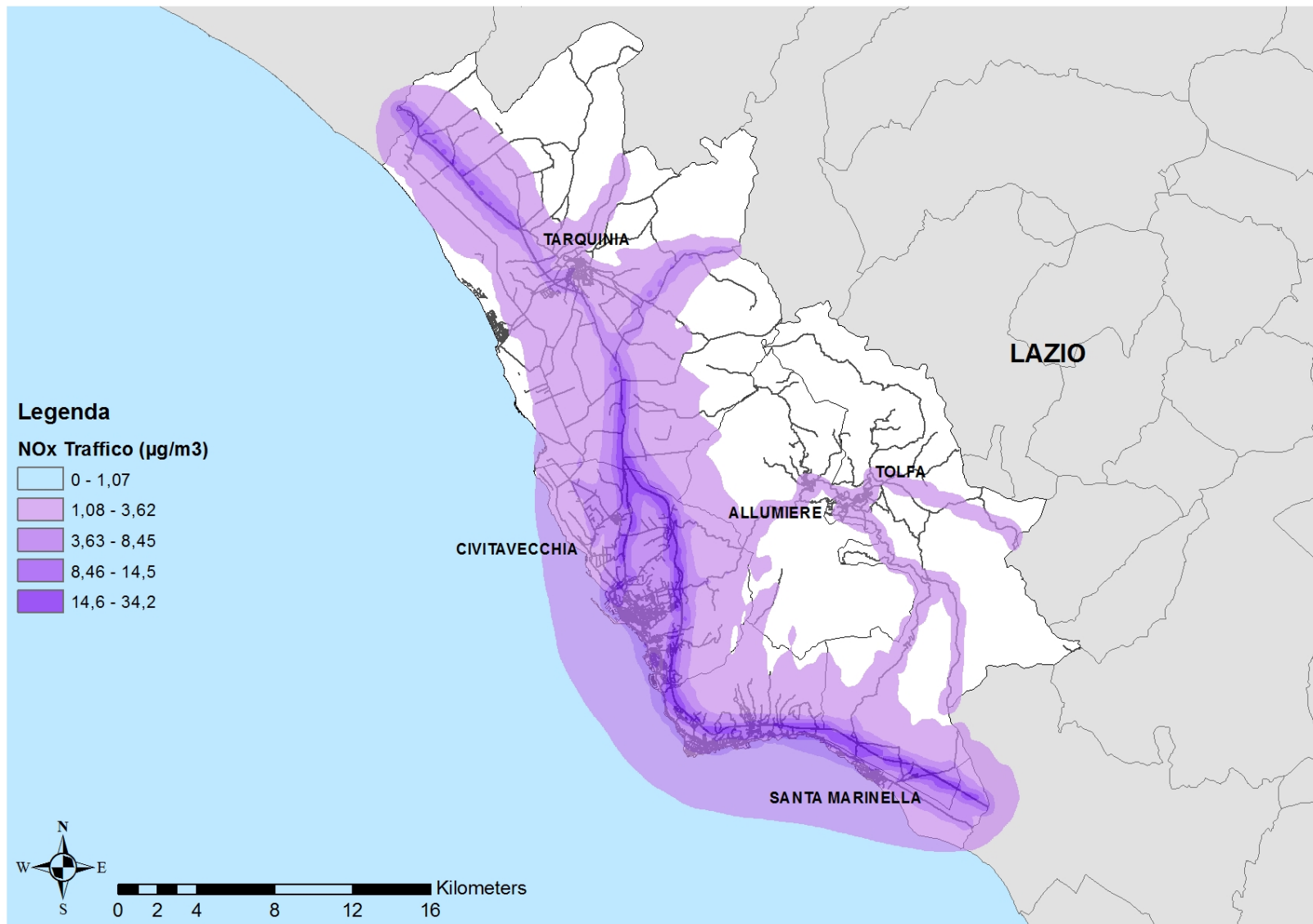
Harbour



Civil heating (biomass burning) – PM $\mu\text{g}/\text{m}^3$



Urban traffic – NOx $\mu\text{g}/\text{m}^3$



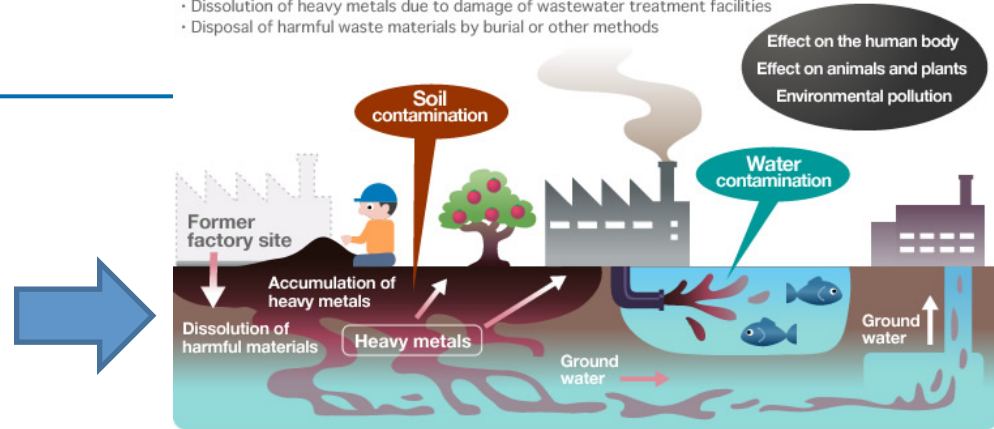
HBM

Biomonitoring the concentrations of metals in blood or in urine allows to **assess the human contamination** to environmental pollutants through **all routes of exposure**

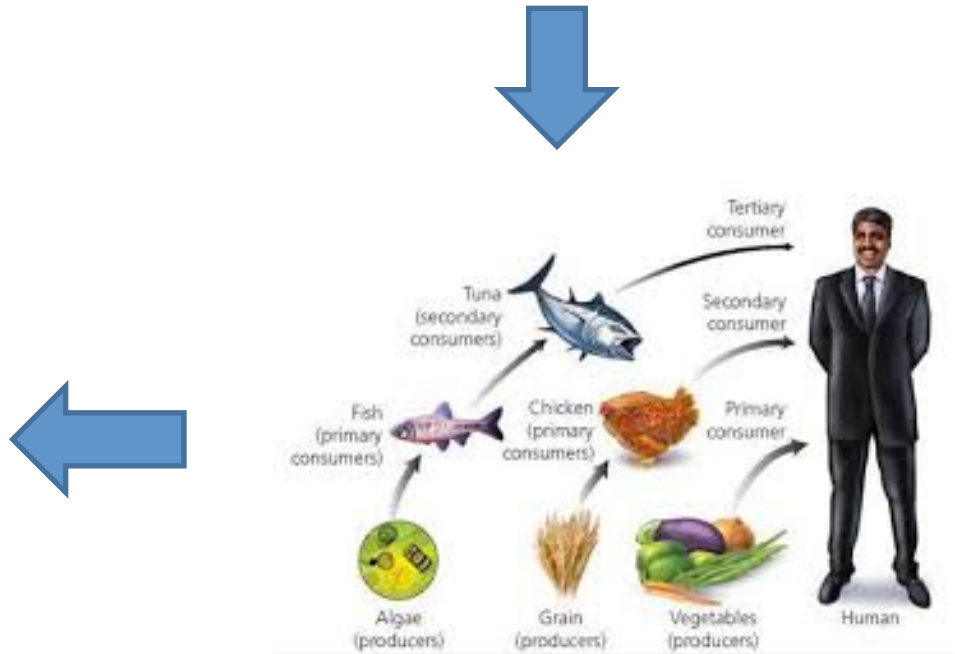
Disease or not disease



- Accumulation of heavy metals due to production activities
- Dissolution of heavy metals due to damage of wastewater treatment facilities
- Disposal of harmful waste materials by burial or other methods



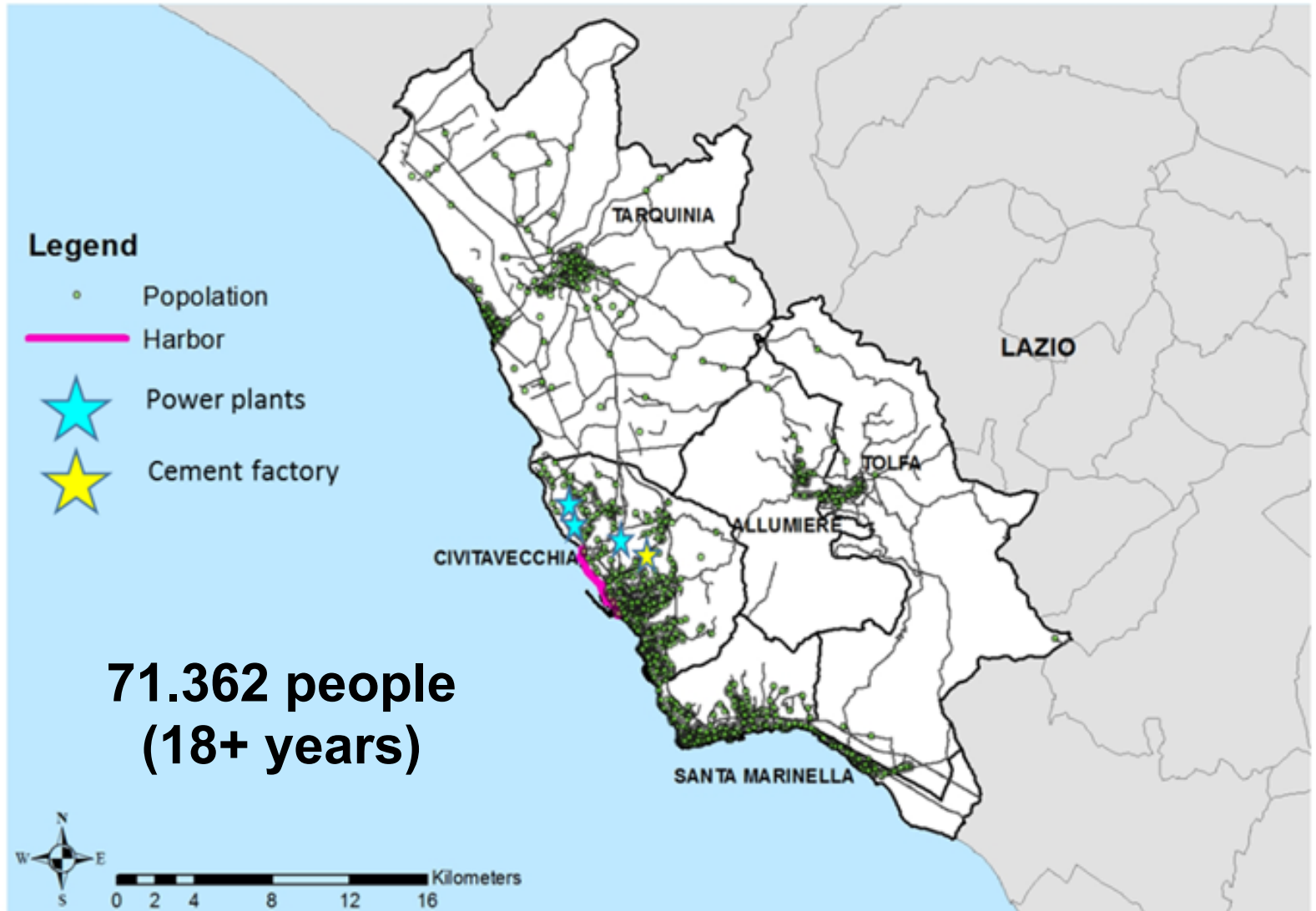
Contamination of soil, plants and animals



Food chain

Population

municipality registers



ABC study

Period: 2013-2014

Population: A sample of 2000 residents (age 35-69) was randomly selected from the Municipal Register's data and their residence addresses were geocoded.



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ABC study participants

Contacted
1790

Respondents
1177 (65,7%)

613 refuse

Availability of medical examinations
1141 (96,9%)

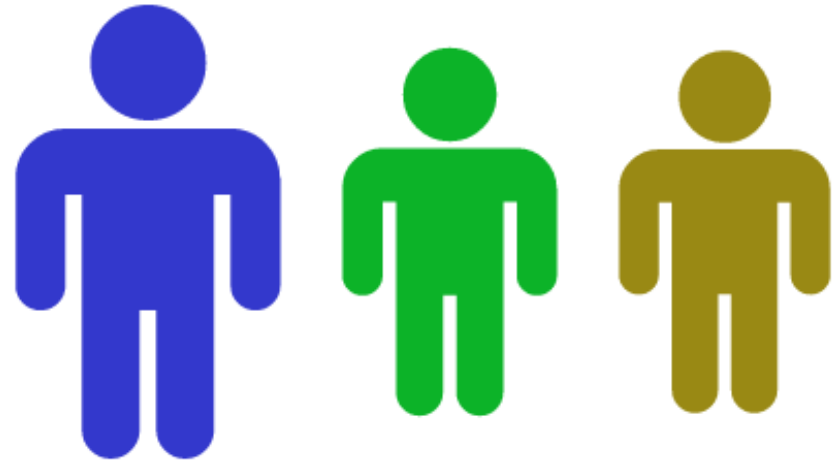
Sample
Availability

Blood
1131 (96%)

Urine
1128 (95,8%)

Nails
435 (36,9%)

Hair
395 (33,6%)



● Sample ● Respondents ● Availability of medical examinations

Exposure assessment (*Biomarkers*)

Biomarkers	NHANES - USA	Other literature
Antimony (Sb)	coal combustion	diet; drinking water
Arsenic (As)		coal plant; harbor; diet; drinking water
Berillium (Be)	coal combustion; smoking	Smoking; diet; drinking water; hazardous waste
Cadmium (Cd)	coal combustion; smoking	Coal plant; harbor; smoking
Cobalt (Co)	coal and oil combustion; traffic	dietary supplements
Chrome (Cr)		Coal plant; harbor; traffic; galvanic industry; smoking; diet
Copper (Cu)		Coal plant, harbor; traffic
Iridium (Ir)		traffic
Lead (Pb)	coal combustion	Harbor; diet; drinking water
Manganese (Mn)		harbor; combustion; diet
Mercury (Hg)	coal combustion; diet	coal plant; diet
Molybdenum (Mo)		coal plant; diet; drinking water
Nickel (Ni)		Coal combustion; harbor; traffic; smoking; diet; jewelry; detergents
Palladium (Pd)	traffic	traffic
Platinum (Pt)		traffic
Rhodium (Rh)		Traffic
Tallium (Tl)	coal combustion	coal combustion
Tin (Sn)		coal combustion; petroleum; consumption of canned foods
Tungsten (W)		combustion; cement plant; drinking water
Vanadium (V)		harbor; fossil fuels; diet
Zinc (Zn)		combustion; traffic; diet

Biomarkers	Metabolite	Other literature
Acid S-phenylmercapturic (SPMA)	benzene	smoking; traffic; industrial pollution
Cotinine	Nicotine	smoking

Metabolite PAH	Other literature
1-OH pyrene	traffic
1-OH naphthalene	smoking
2-OH naphthalene	smoking
1+9 OH phenanthrene	traffic; combustion
2-OH phenanthrene	traffic; combustion
3-OH phenanthrene	traffic; combustion
4-OH phenanthrene	traffic; combustion
2-OH fluorene	combustion



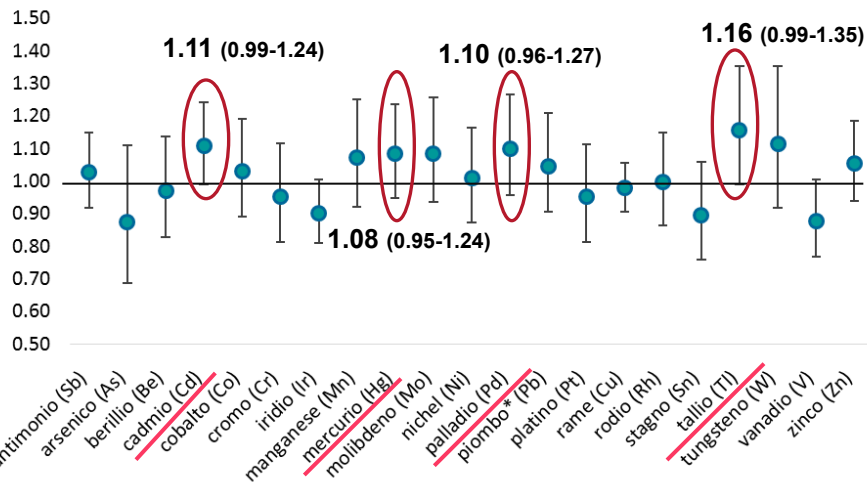
Geometric mean of urinary (adjusted for urinary creatinine) and blood concentration of heavy metals of the sample (SD, median 95th-5th percentile) and comparison with other studies.

	POPOLAZIONE ABC totale	Torino*	Italia ²⁰⁰⁹	NHANES
antimonio (Sb) µg/gr creat	0.06	0.06	0.07 [2005]	0.05 [2013]
arsenico (As) µg/gr creat	19.36	16.86	16.7 [1990]	8.15 [2013]
berillio (Be) µg/gr creat	0.13	0.15	0.4 [1990]	<0.072 [2013]
cadmio (Cd) µg/gr creat	0.42	0.66	0.81	0.18 [2013]
cobalto (Co) µg/gr creat	0.23	0.16	0.24	0.38 [2013]
cromo (Cr) µg/gr creat	0.13	0.15	0.21	1.0 [2000]
iridio (Ir) ng/gr creat	0.88	1.66	2 [1990]	
mercurio (Hg) µg/gr creat	1.17	1.46	1.92	0.40 [2013]
manganese (Mn) µg/gr creat	0.11	0.12	0.22	0.137 [2012]
molibdeno (Mo) µg/gr creat	38.34		36.9	38.6 [2012]
nichel (Ni) µg/gr creat	0.81	0.88	0.87	2.4 [2000]
palladio (Pd) µg/gr creat	16.02	23.01		
piombo nel sangue (Pb) ng/l	20.19	18.27	26.4	10.7 [2013]
platino (Pt) ng/gr creat	2.57	3.1	2 [2004]	<0.009 [2013]
rame (Cu) µg/gr creat	7.05	10.07	12.9	0.393 [2012]
rodio (Rh) ng/gr creat	16.65	18.37	15 [2004]	
stagno (Sn) µg/gr creat	0.32	0.55	0.9	0.665 [2012]
tallio (Tl) µg/gr creat	0.4	0.26	0.07 [1994]	0.16 [2013]
tungsteno (W) µg/gr creat	0.14		0.08 [2005]	0.074 [2012]
vanadio (V) µg/gr creat	0.04	0.03	0.14	
zinco (Zn) µg/gr creat	283.22	362.81	356	231 [2000]

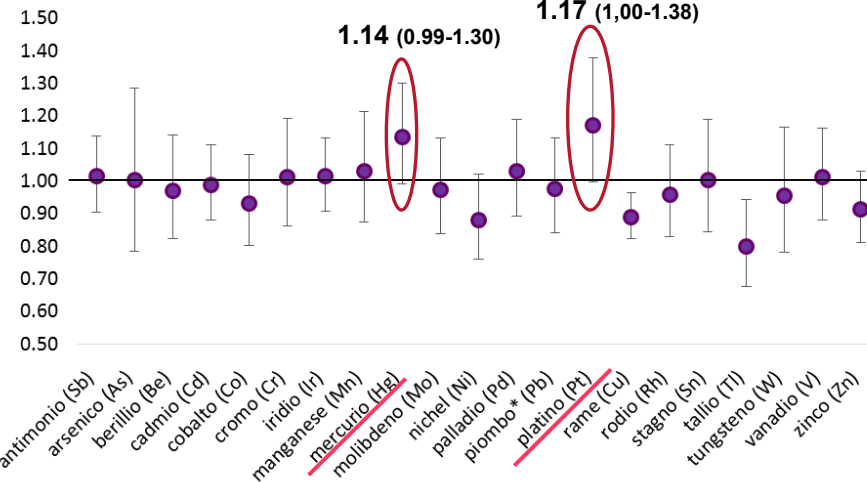
* relazione programma SPoTT (10)

Associazione tra indicatori di esposizione e concentrazione urinaria di metalli pesanti - GMR, 95% I.C.

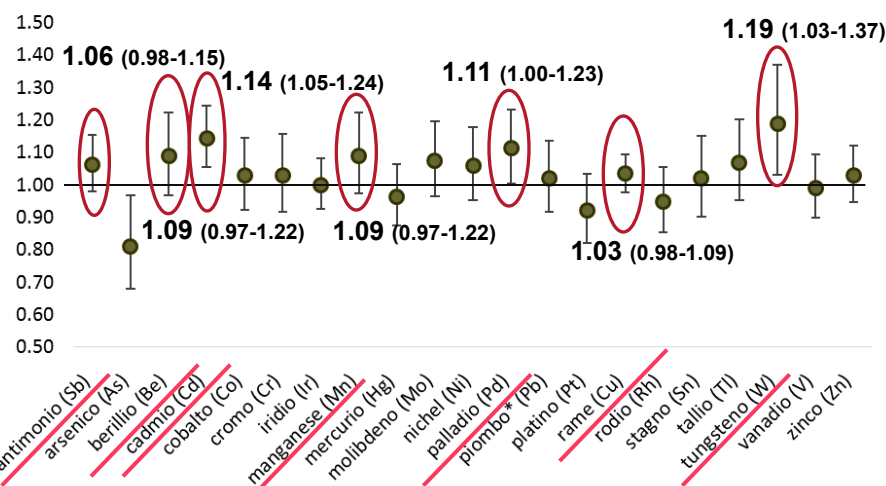
PM₁₀ da Centrale a carbone 95°p-5°p=0.005



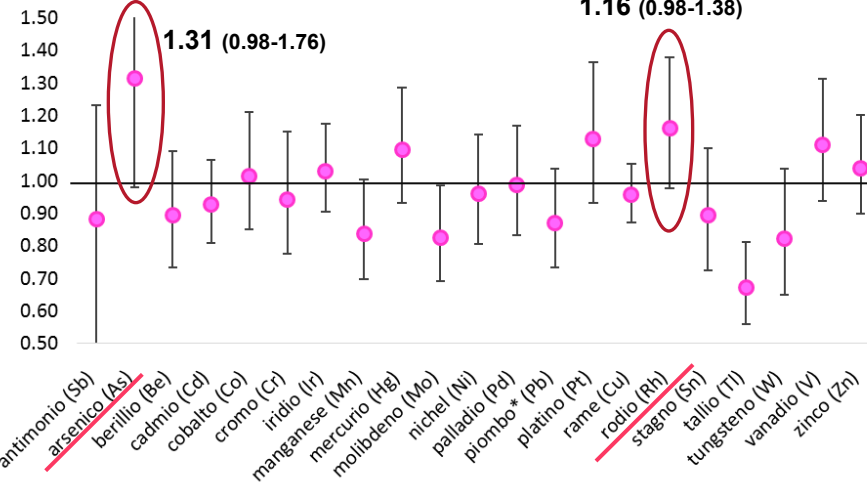
NO_x da Traffico 95°p-5°p=15.2



PM₁₀ da Camini 95°p-5°p=4.22



PM₁₀ da Porto (stazionamento) 95°p-5°p=0.065



GMR aggiustate per concomitanti esposizioni ambientali, creatinina, periodo di arruolamento, caratteristiche demografiche, fattori di rischio (*backward procedure*)

Conclusion:

Coal combustion (power plant biomass burning):

**Cadmium – Mercury – Thallium – Antimony –
Berillium – Manganese – Molybdenum – Copper–
Tungsten**

Traffic (road and ships): Platinum – Rhodium –
Arsenic

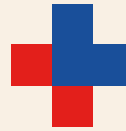
Dispersion models are a valid tool for estimating the individual exposure of populations living in industrially contaminated areas.



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