Mérieux NutriSciences

Better Food. Better Health. Better World.

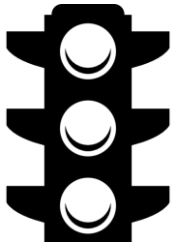
Ultrafine particles and nanoparticles in the air: an innovative system to monitor their speciation and concentration

Sylvain Mourard, Responsable Commercial France – Eau & Environnement, Mérieux NutriSciences

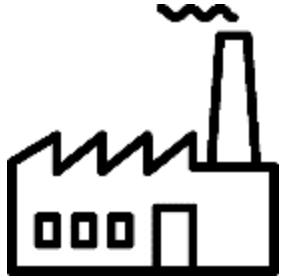
Our company

Sampling and analysis
ENVIRONMENTAL SERVICES

Origin of nanoparticles in the air



traffic



industries

sea aerosol

NANOPARTICLES

forest fires

natural occurrence

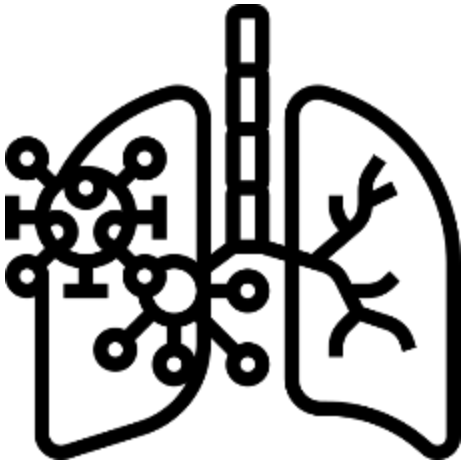
harbour activities

district heating

Nanoparticulate: epidemiology and toxicology

EXPOSURE TO NANOPARTICULATE

- increased risk of lung disease
- allergic reactions
- increases the risk of heart attack



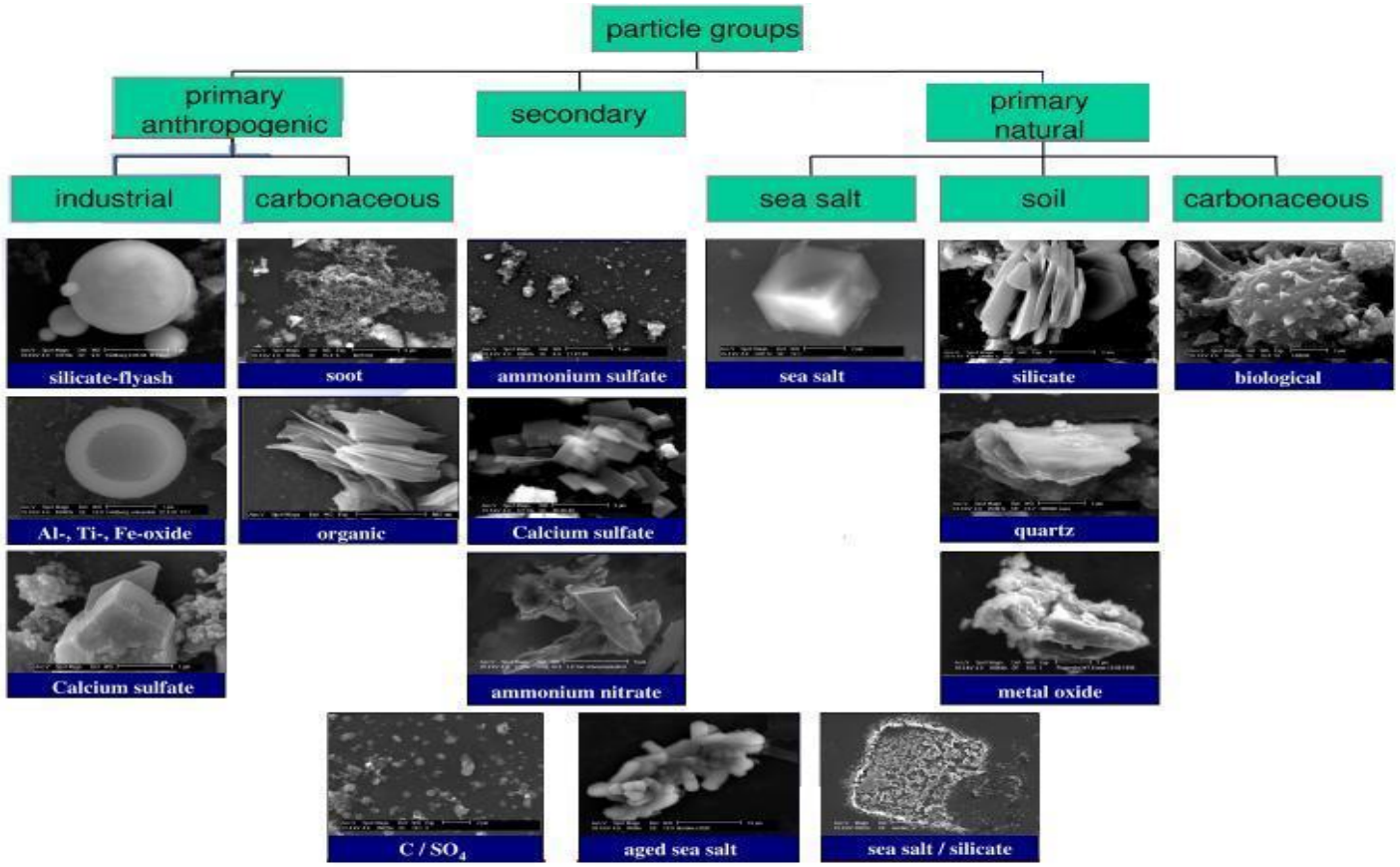
NANOPARTICULATE IS DANGEROUS

- it can cross the membrane of the pulmonary alveoli
- it can be transported to all organs

Nanoparticulate identification

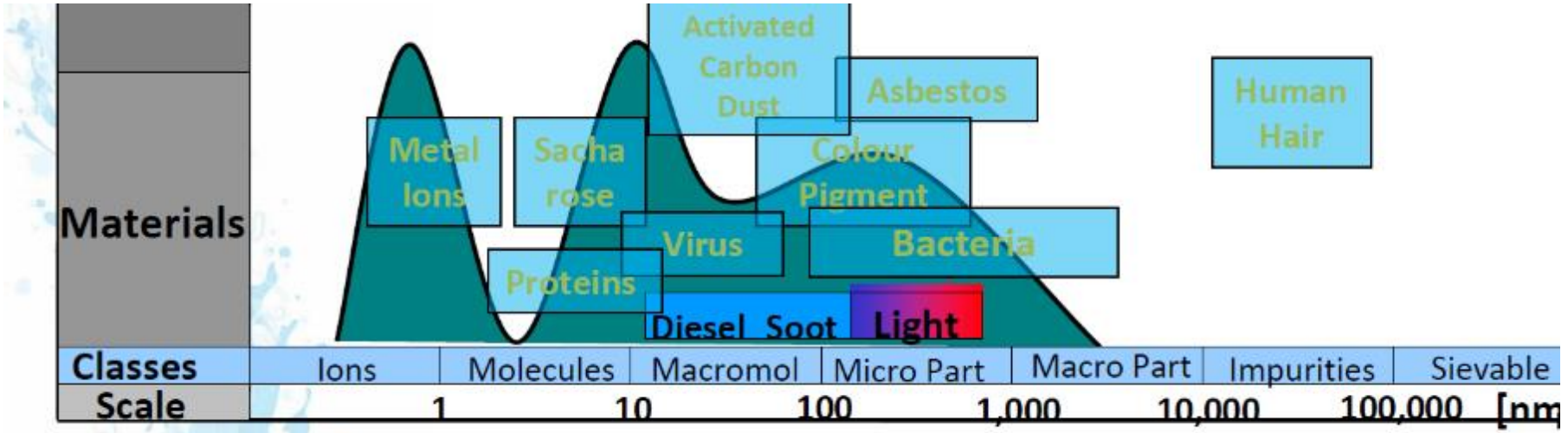
- SHAPE
- SIZE
- CHEMICAL COMPOSITION

allow classification and identification source of the particles



Particulate concentration/dimensional distribution

Environment	Concentration
Indoor	~ 5,000 – 15,000 P/cm3
Indoor with smokers	~ 15,000 – 80,000 P/cm3
Diesel engine	< 1010 P/cm3



Main characteristics of nanoparticles in the air

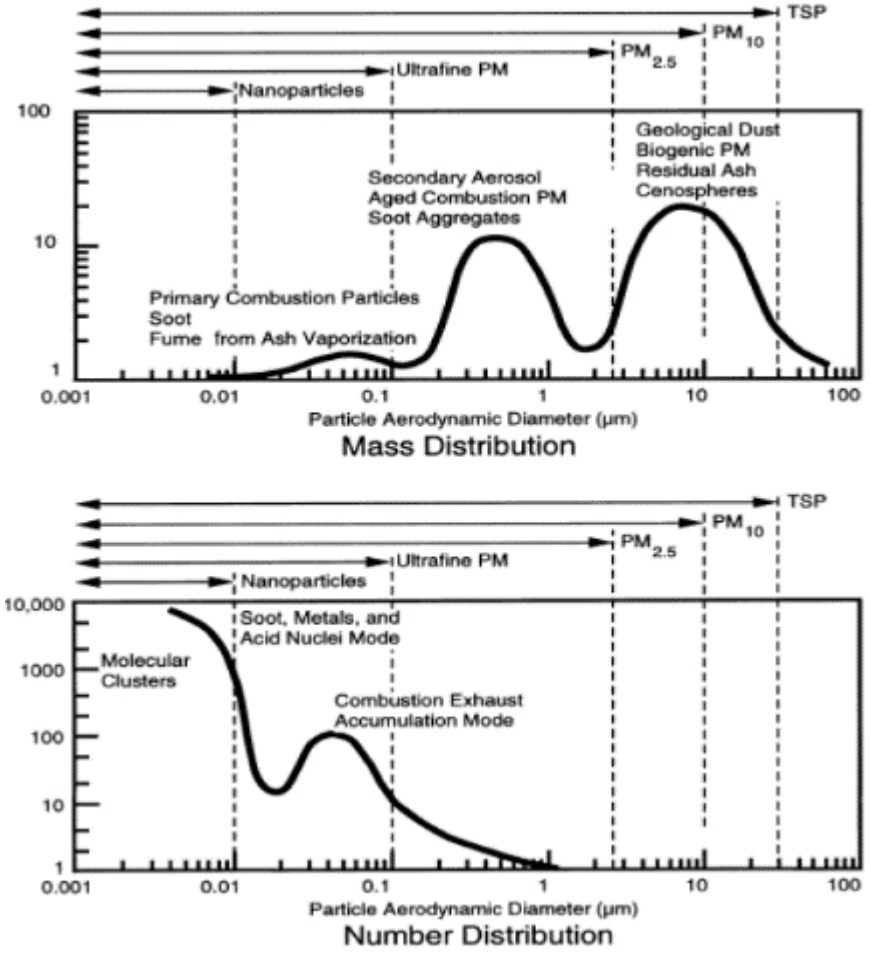
- They remain for **long time in suspension in the air**, and for this they have **longer residence time**
- They have **high probability of penetration** and deposition in respiratory or cardiovascular systems
- They have high surface area per unit of volume if compared to larger particles: **this increases the ability to absorb organic compounds**, some of which are potentially carcinogenic

Existing studies

Most of the studies and also legislation on air pollution are concerned on the MASS of the particulate.

Is that the right parameter to considered?

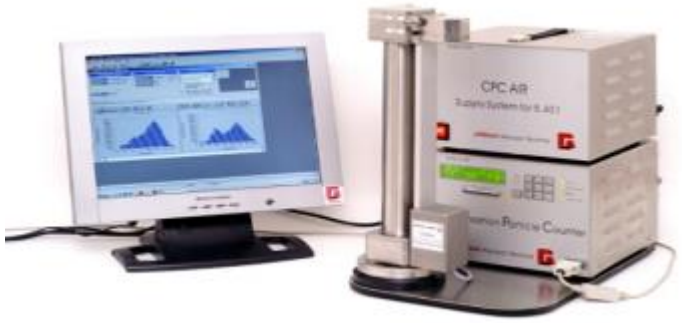
We also need to focus on **distribution, origin, chemistry** to better understand the phenomenon.



Particles distribution in the air – volumes and number of particles (extracted by NARSTO Particulate Matter Assessment Report, 2003).

Which tests?

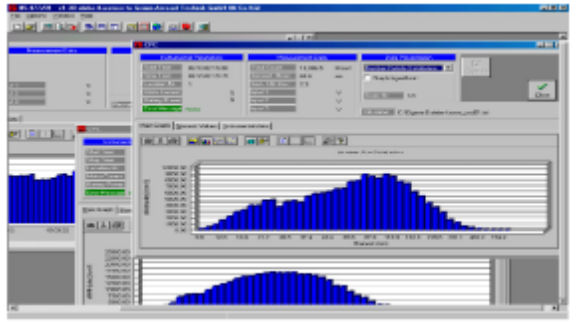
TO INVESTIGATE MASS	TO INVESTIGATE THE NUMBER
Gravimetric methods	Scanning mobility particle sizer (SMPS)
X-ray fluorescence spectroscopy	Diffential mobility analizer (DMA)
ICP-MS	Condensation particle counter (CPC)



Focus on…SMPS

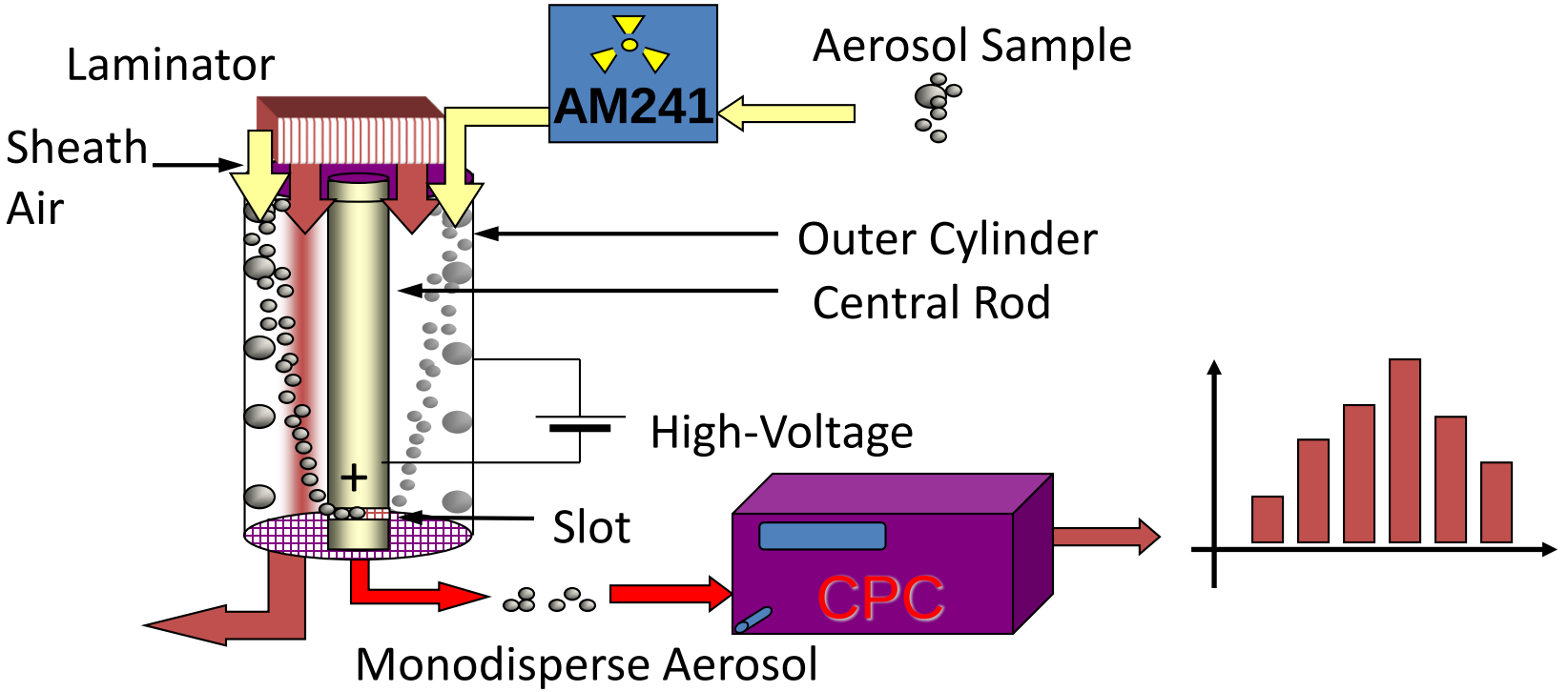
It relies on electrical mobility detection to determine:

- the number
- the size distribution of particles
- data are collected by a specific software which graphically highlight the size distribution



SMPS: how does it work?

SMPS it is a spectrometer which can measure **dimensional distribution and concentrations of particles from 5 to 1100 nm**.

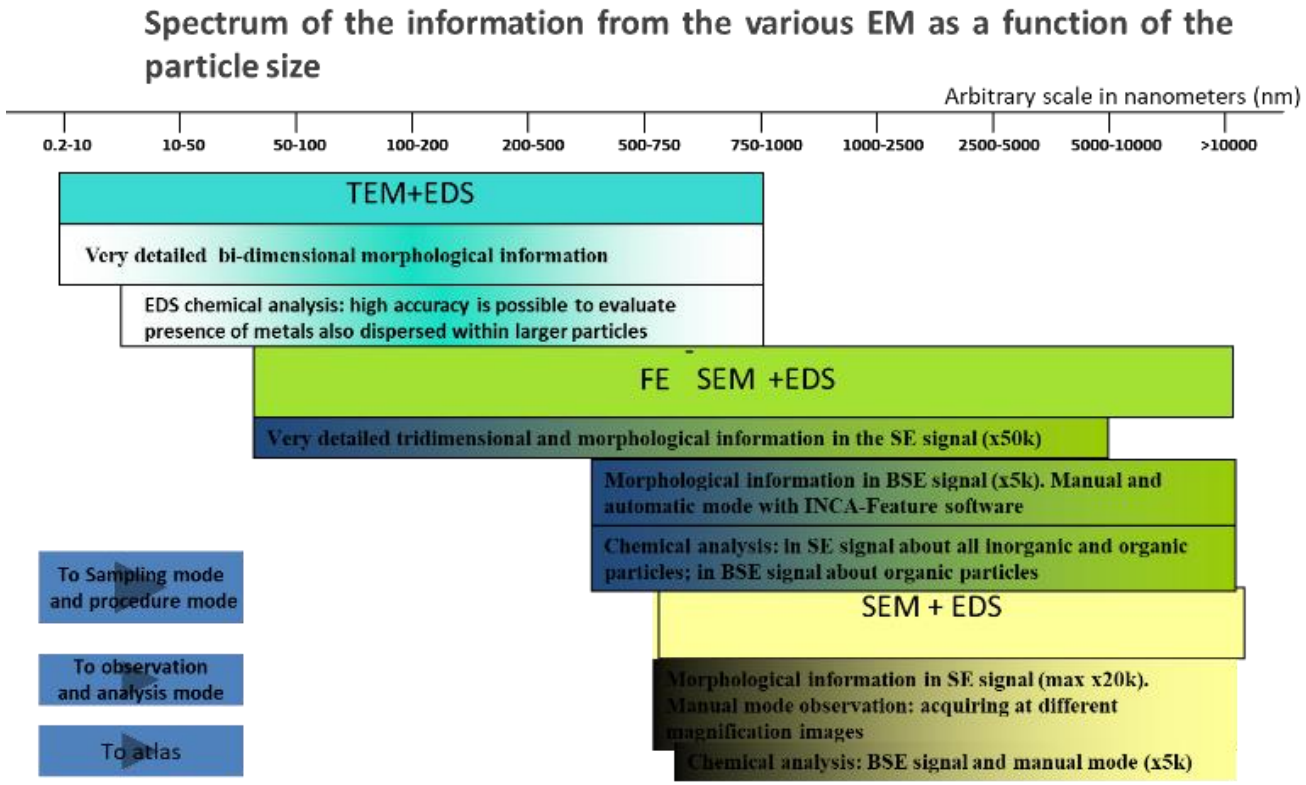


It is made by:

- an electrostatic classifier (DMA, Differential Mobility Analyser)
- a counter (CPC)

Dimensional distribution is highlighted thanks to the voltage variation in the DMA unit: particles are than push to the counter (CPC) by the use of butanol vapour which condensate on them, and making them growing in dimension till they can be detected by a photometric system, which gives back the real time granulometric distribution.

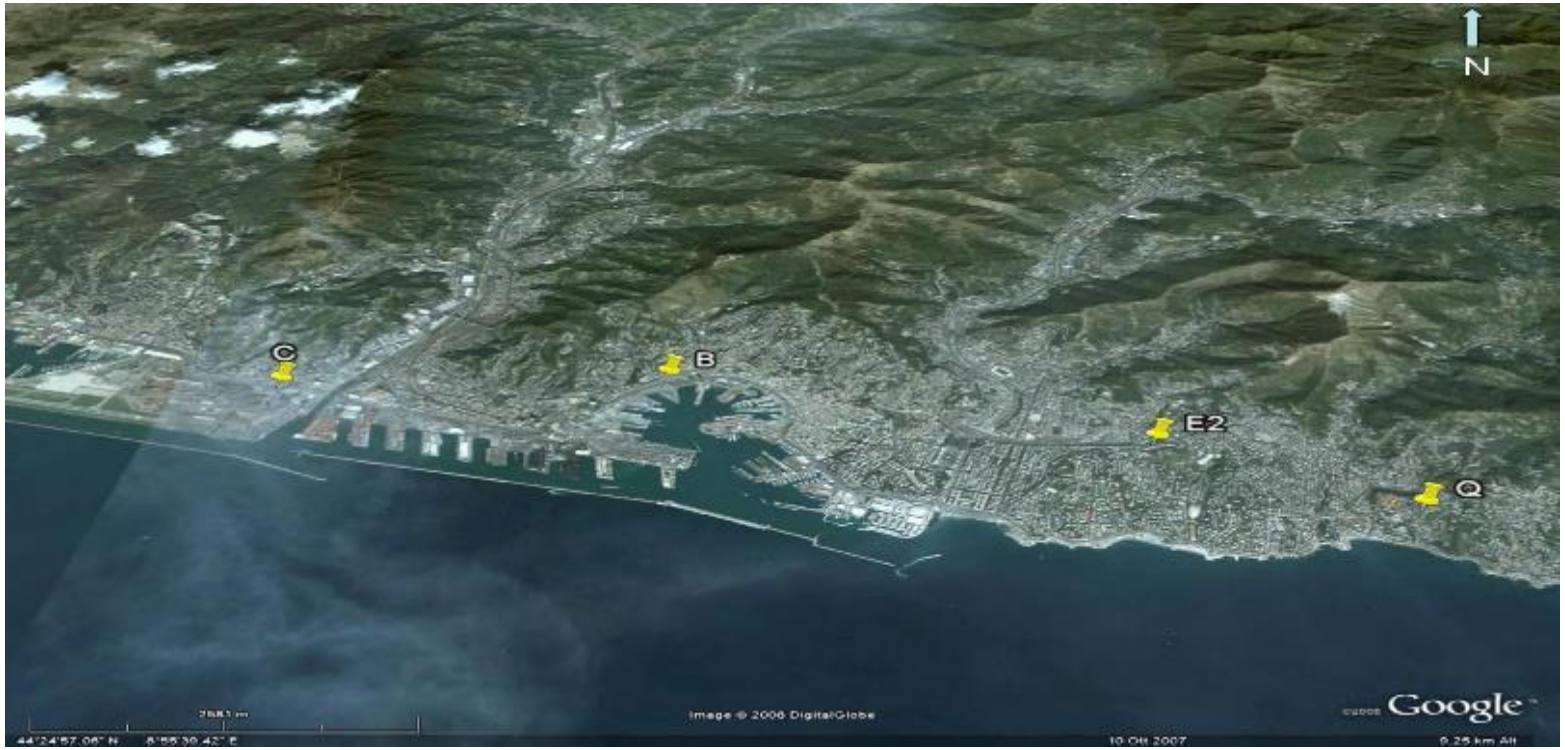
Calibration measurements



Other informations are collected thanks to the use of other equipments, and also helps to calibrate SMPS:

- TEM+EDS
- SEM+EDS
- Field Emission (FE) SEM

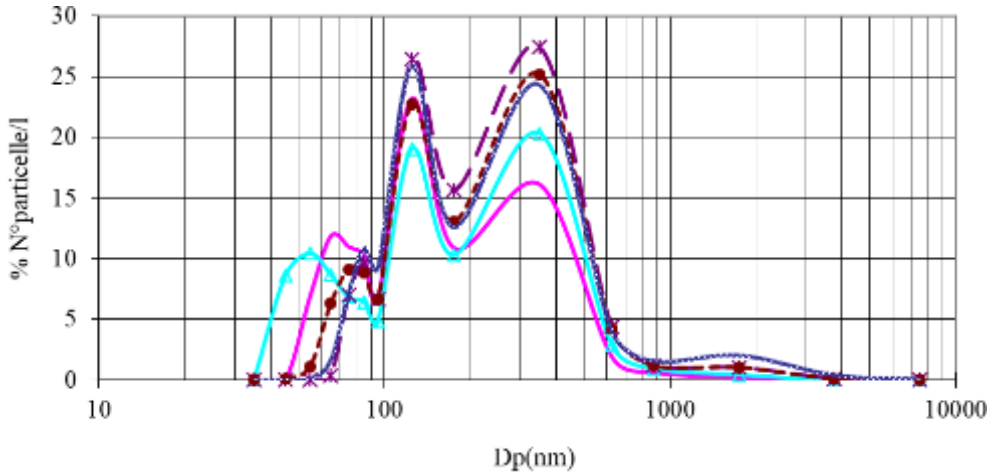
Case study: City of Genova



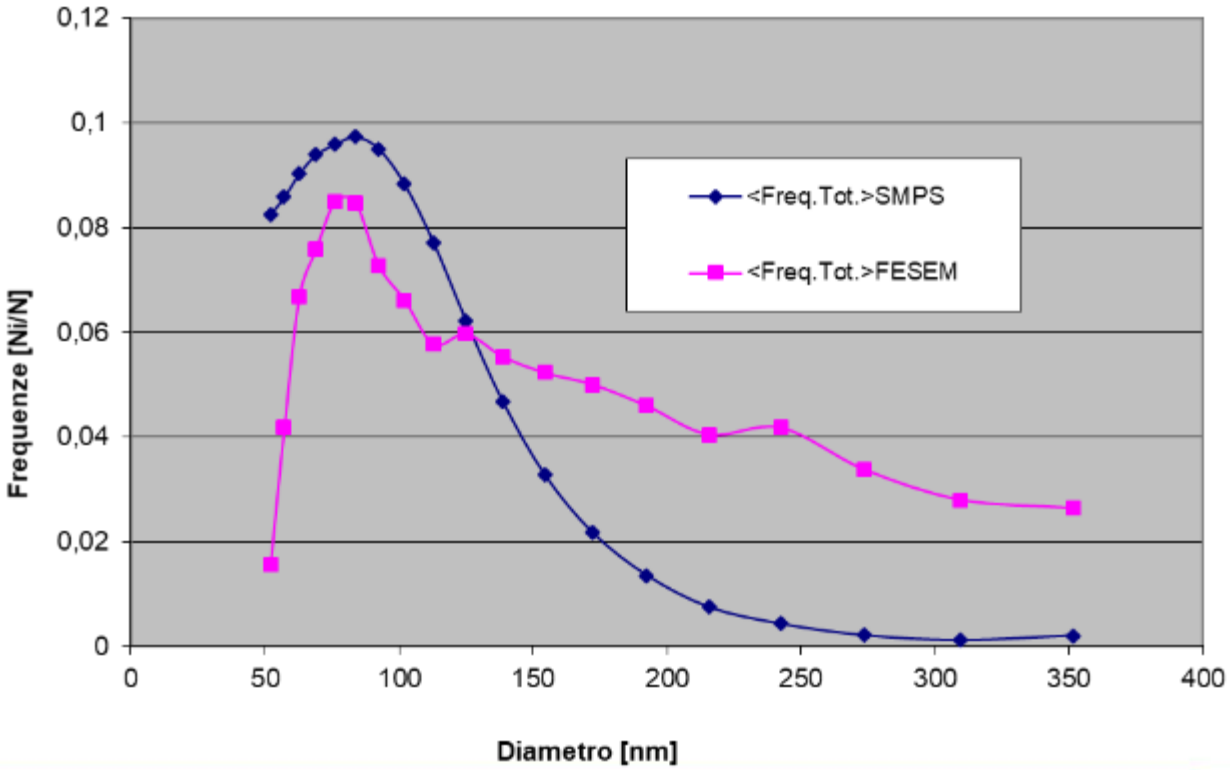
E2: road traffic
B: harbour, thermoelectric plant, city center
Q: area taken as reference for natural presence of nanoparticles in the city
C: industrial activites

Case study: results

E2, *traffic context*

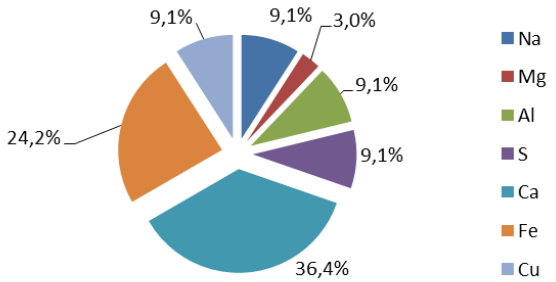


Comparison of the frequencies from SMPS monitoring and FE-SEM monitoring

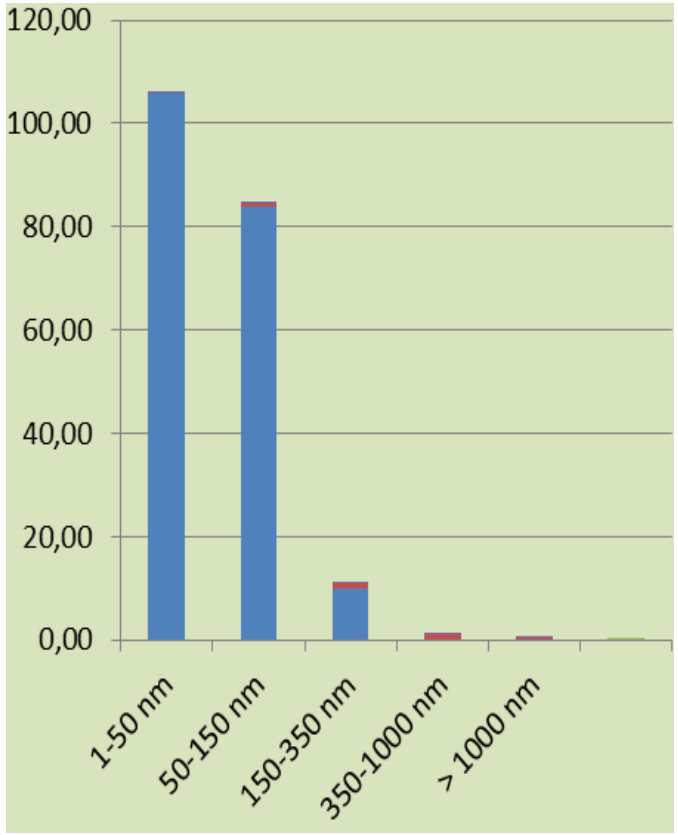


Case study: results

Cluster	1-50 nm	50-150 nm	150-350 nm	350-1000 nm	>1000 nm
	A [%]	B [%]	C [%]	D [%]	E [%]
Combustion sources (stable or mobile)	53	42	5	0	0
From land	5	20	28	34	13
From the sea	11	18	24	17	30
From other antropic sources	19	34	28	8	11



Chemical composition observed at FE-SEM (without considering C and Si)

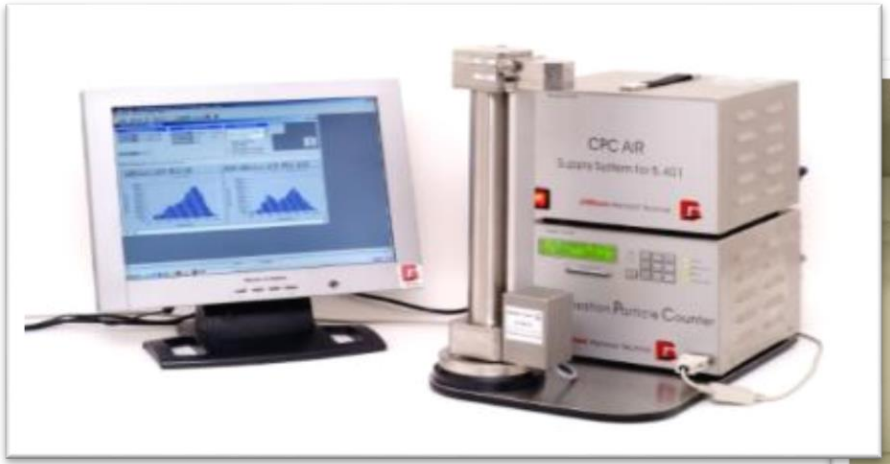


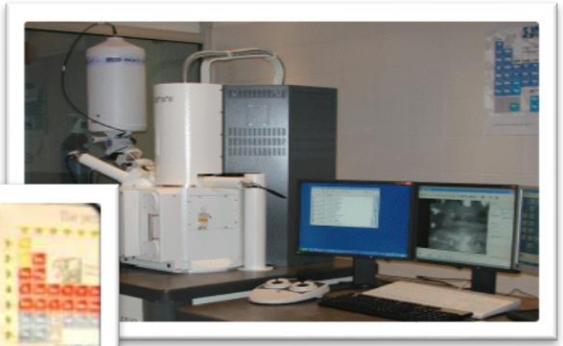
- Combustion sources contributes the most for little nanoparticles
- Land contributes the most for bigger nanoparticles

Conclusions

Particle counter spectrometer SMPS (Scanning Mobility Particle Sizer), with the calibration made with electronic microscopies is useful to:

- evaluate the degree of pollution from nano-particulate
- evaluate the contributions given by different sources
- have deep information on the number and the size distribution of particles





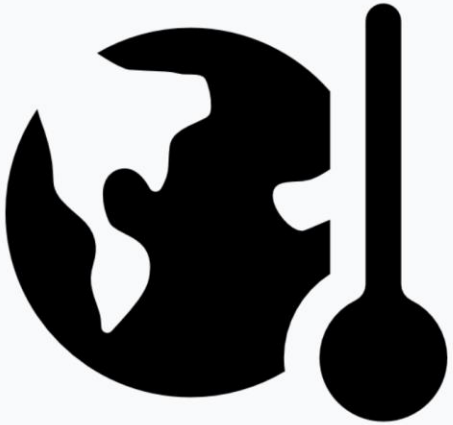
Mérieux NutriSciences

Nanoparticulate project - phase 2

- **CPG – a Mérieux Nutrisciences company, with the University of Genova**
- Focus on particulate < 0,1 micron and its impact on air quality and climate.

GOALS:

- to develop an **algorithm for the identification of nanoparticulate sources**, starting from in situ distribution monitoring
- to study chemical and climatic effects **by a climatic simulation chamber**
- to develop a **web map and an integrated system of analysis of the impact** at hurban level.



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THANK YOU

FOR YOUR ATTENTION

+33 (0) 684 63 69 49

sylvain.mourard@mxns.com

2 Allée des Sorbiers, 69500 BRON

www.merieuxnutrisciences.com/eu