

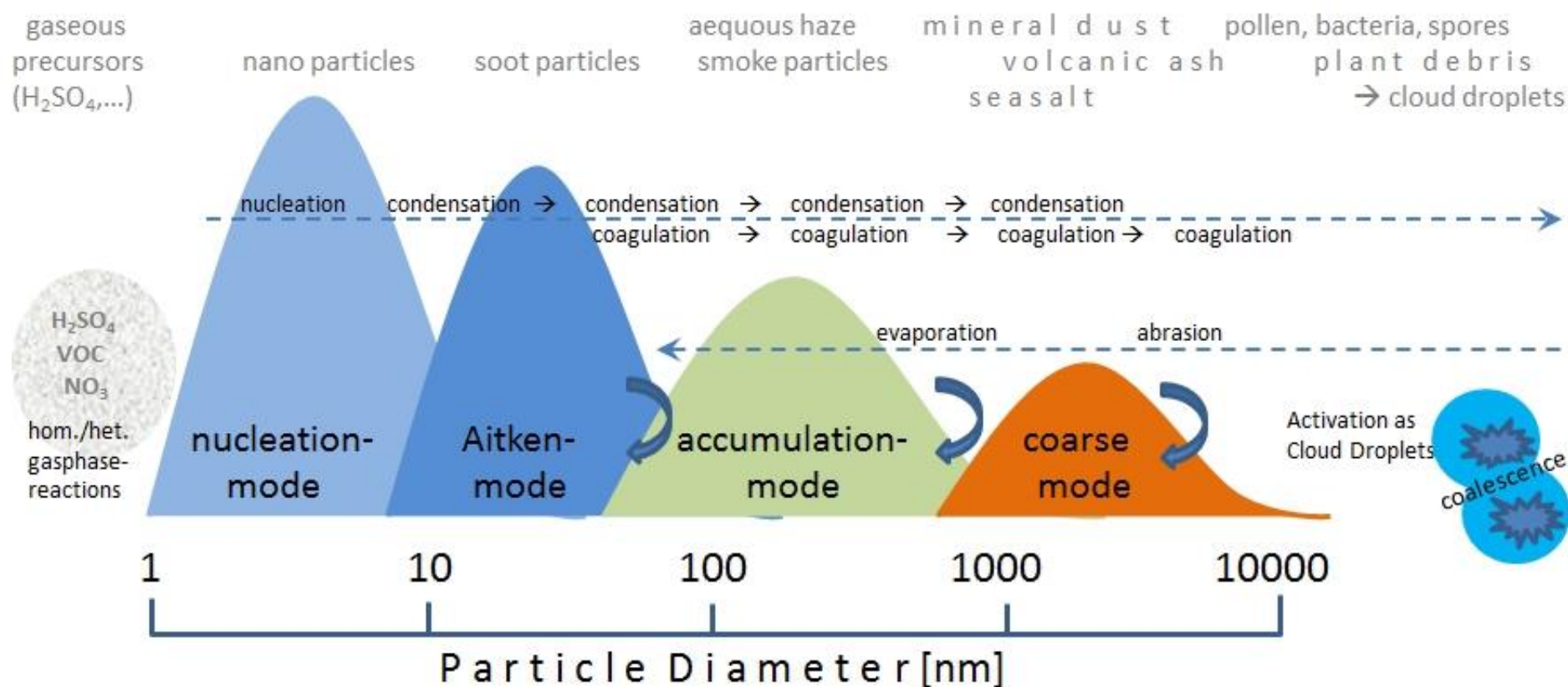
HORIBA France – Jean-Clair BALLOT

AIR LORRAINE– Jean-Eudes PETIT

ANALYSE ELEMENTAIRE DES PARTICULES PM_{2.5} EN CONTINUE DANS L'AIR AMBIANT

PM_{2.5} ELEMENTAL CONTINUOUS ANALYSIS IN AMBIANT AIR

Particle Matter : PM1 ; PM2.5 ; PM10...



Particle sources

Oxydizing gas



Organic compounds

NO_x
 SO_2
 NH_3

→
→
→
→

Organics

Nitrates

Sulfates

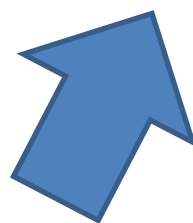
Ammonium



Secondary particles



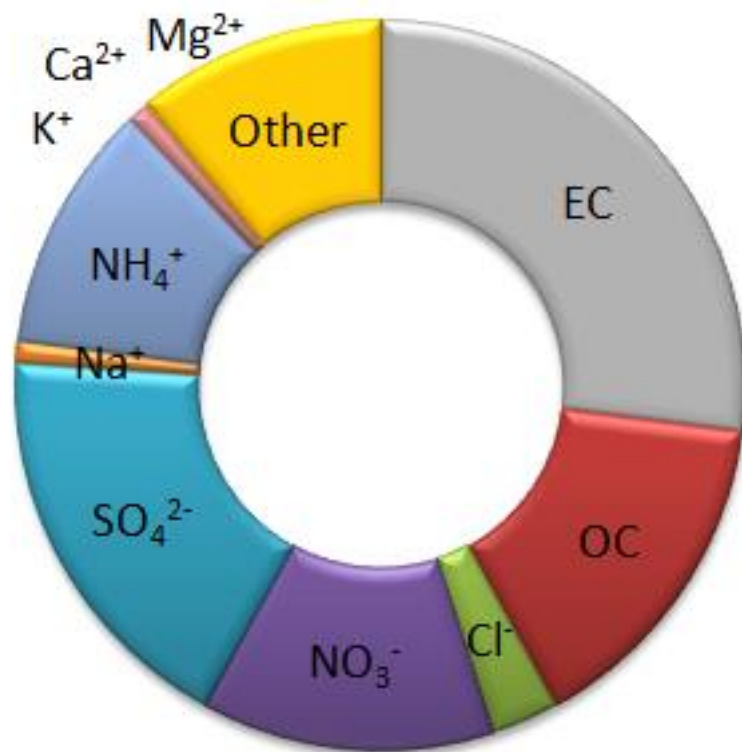
Gas



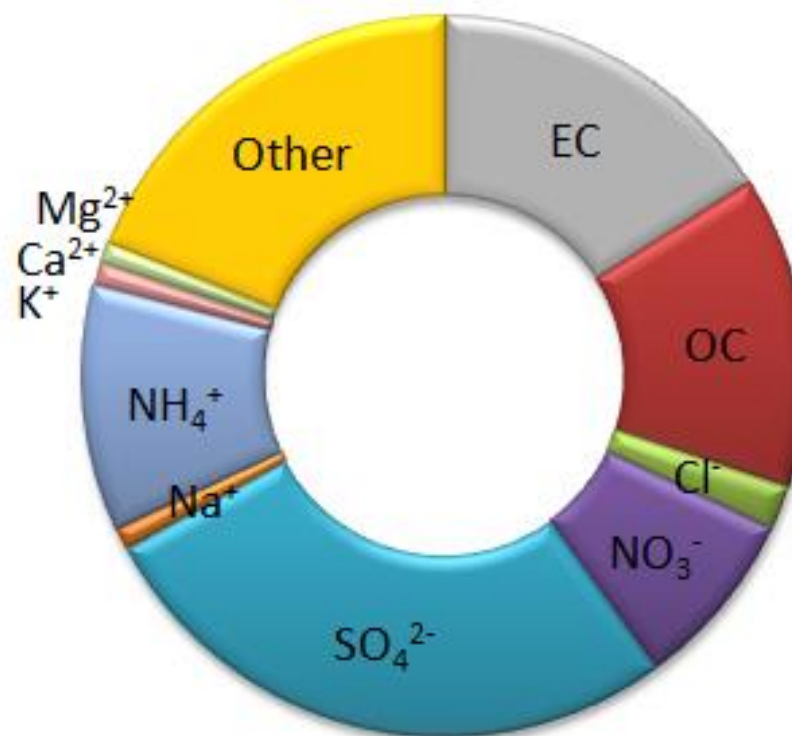
Primary particles



What is PM2.5? - Breakdown of Element of PM2.5 -



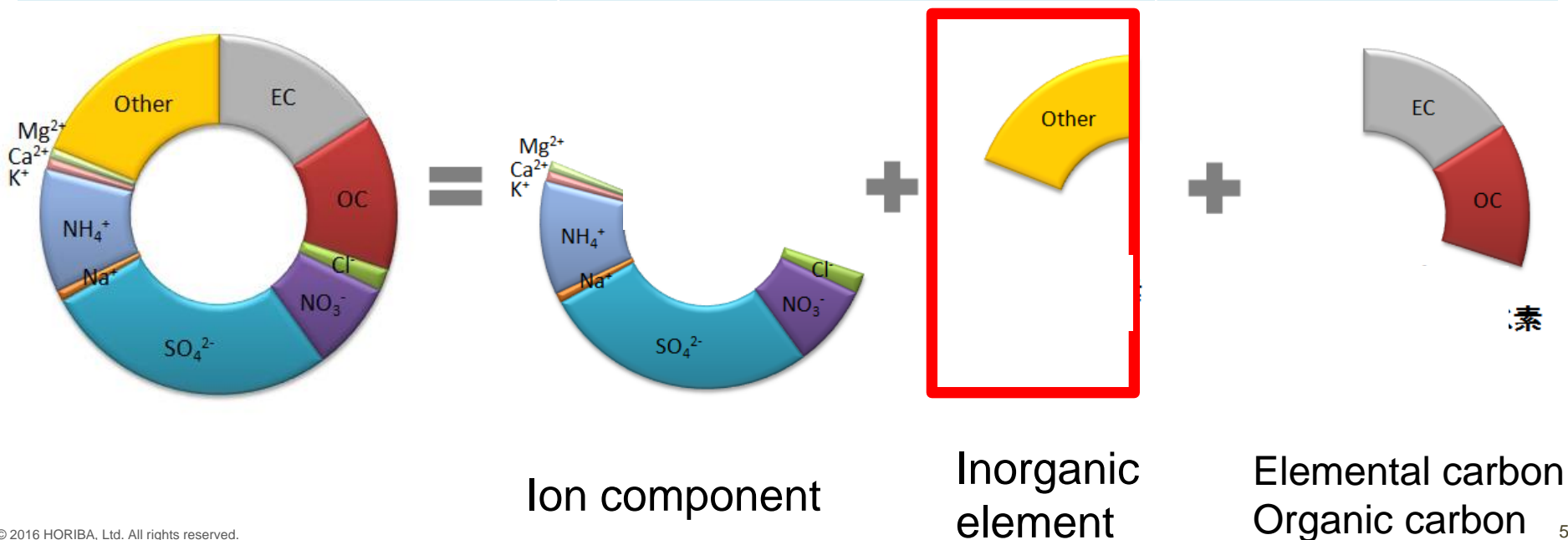
Sample 1



Sample 2

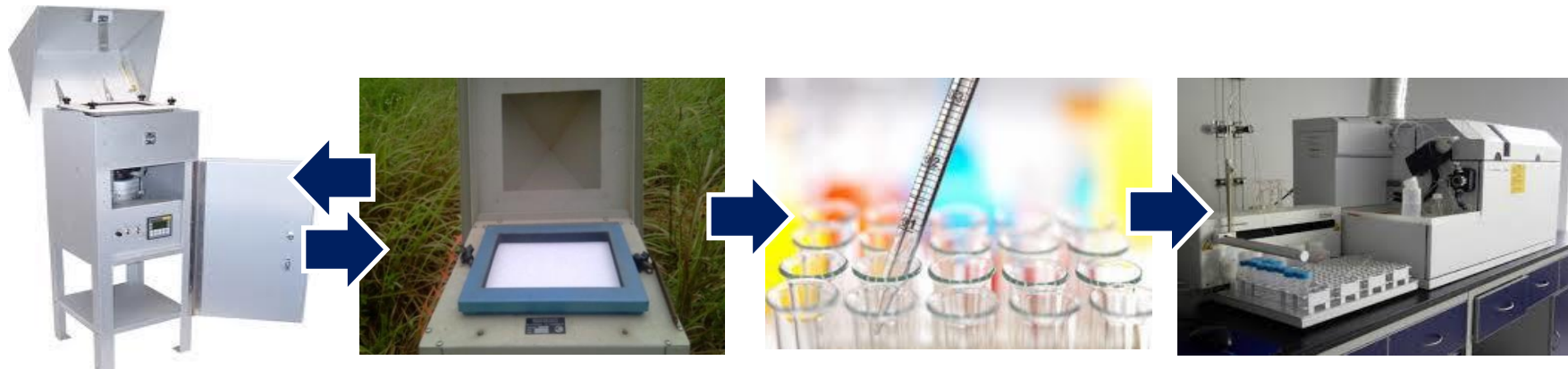
What is PM2.5? - Breakdown of Element of PM2.5 -

Component	Method	Filter
Ion Component	Ion chromatography	PTFE
Inorganic element	ICP-MS or XRF	PTFE
Polycyclic aromatic hydrocarbon	HPLC or GC-MS	PTFE
Elemental Carbon Organic Carbon	Thermal/Optical Method	Quartz fiber



Why we have developed PX-375?

■ Conventional Method



Sampling

**Filter
Replacement**

Pretreatment

Analysis

1. A lot of human cost & time
2. Difficult to catch trend
3. Bias with the mix of field & Lab analysis

Continuous PM & Elements Analysis with Single Compact Unit



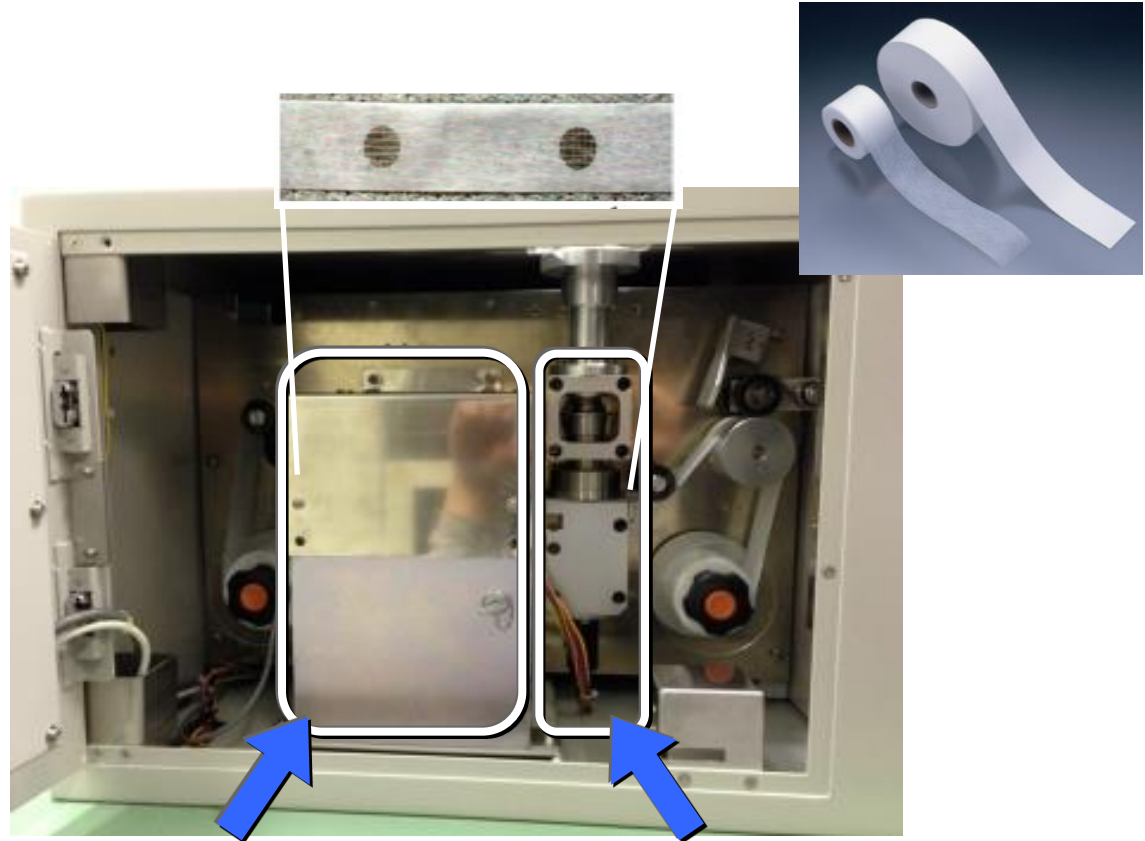
← Sampling Head/Inlet
(TSP, PM10, PM2,5)

← Condenser Unit

← Main Unit – Beta Ray & XRF
X-ray Identification light

Dimension: 450(w)x550(l)x 285(h) : mm
Weight: Appro 40Kg

Continuous PM & Elements Analysis with Single Compact Unit



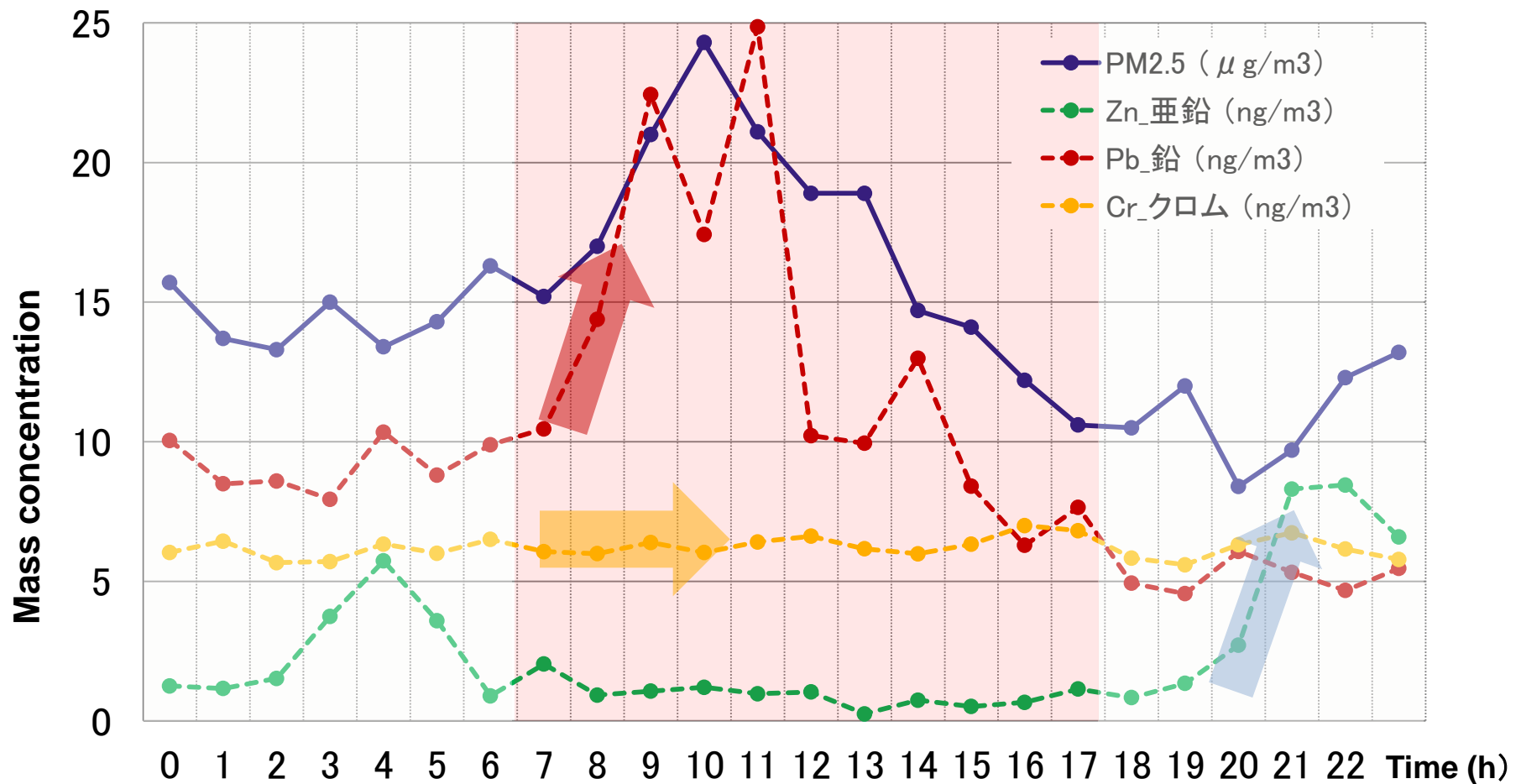
Elemental Analysis Mass Analysis
< XRF > < Beta-ray >
Internal View

Detectable Elements

H	<div> <div></div> Detectable Elements </div>																He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra		Rf	Ha	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Unt	Fl	Unp	Lv	Uus	Uno
lanthanoid			La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
actinoid			Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

15 standard elements

Why we have developed PX-375?



We might be able to know what elements contributes to increase PM by catching the trend

EU Regulation

Regulation Levels in EU are limits in yearly average in Europe by Law.

As : 6ng/m³

Ni : 20ng/m³

Pb : 500 ng/m³

Cd : 5 ng/m³

Typical values of are encountered in France (background):

As : 1 ng/m³

Ni : 2 ng/m³

Pb : 10 ng/m³

Cd : 0,5 to 1 ng/m³

PX-375 detection limits
(Source HORIBA,

1000s analysis time, 2σ)

As (<0.0 ng/m³)

Ni (? ng/m³)

Pb (1.7 ng/m³)

Cd (7.4 ng/m³)

Air Lorraine: Regional association for air quality monitoring in Lorraine

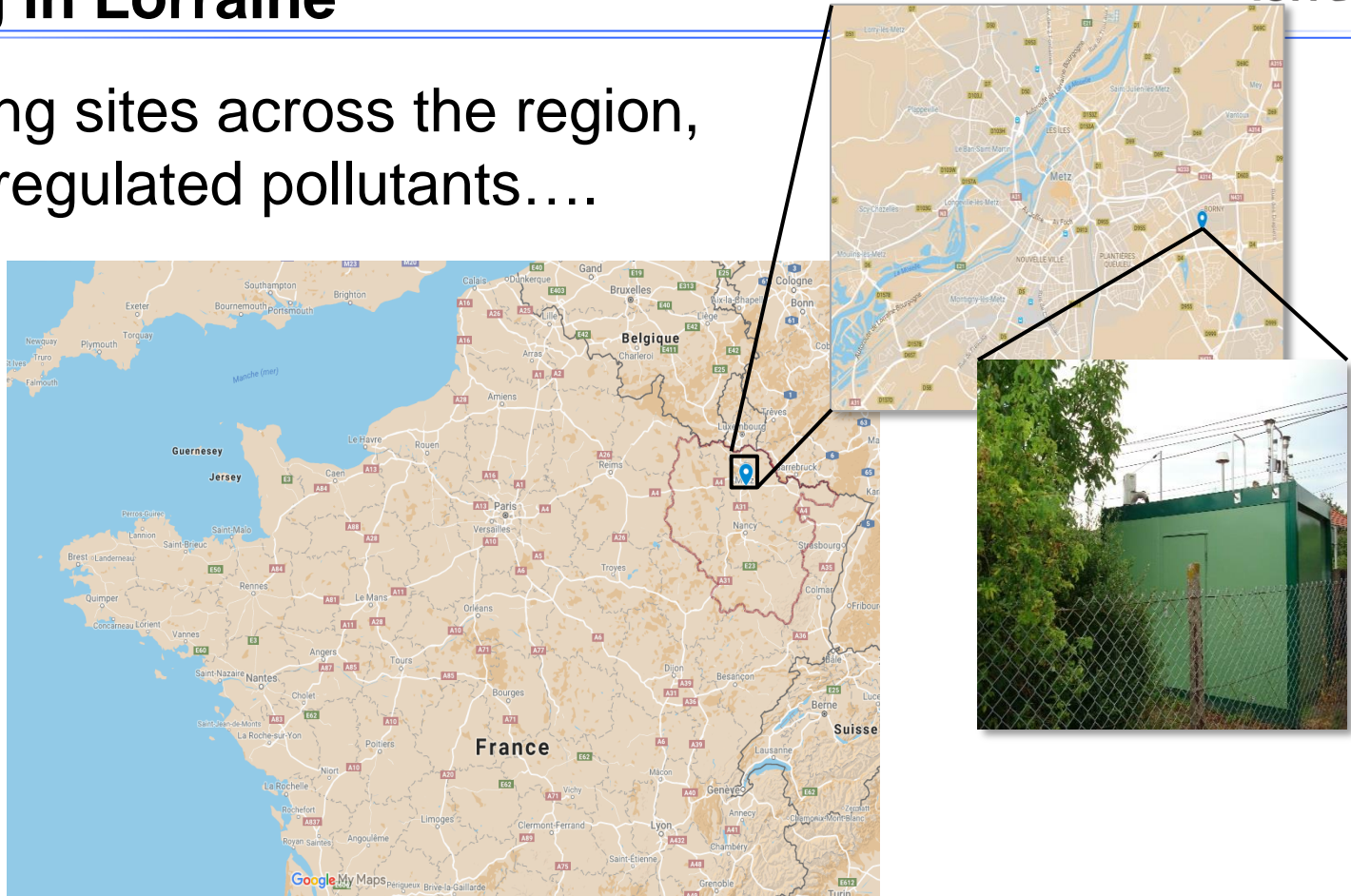
47 monitoring sites across the region,
measuring regulated pollutants....



... as well as more specific pollutants, especially regarding
the chemical composition of aerosols

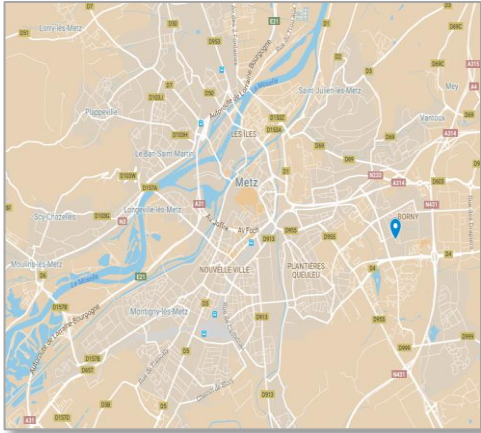
Air Lorraine: Regional association for air quality monitoring in Lorraine

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... as well as more specific pollutants, especially regarding the chemical composition of aerosols

Metz – Borny station: Urban background measurements within Metz metropolitan area



Aerosol Chemical Speciation Monitor (Aerodyne Inc.)

Organic Matter
Nitrate
Ammonium
Sulfate
Chloride



AE33 7-wavelength Aethalometer (Magee Scientific)

Black Carbon → BC fossil fuel
BC biomass burning



NH₃/H₂O analyzer (Los Gatos Research)

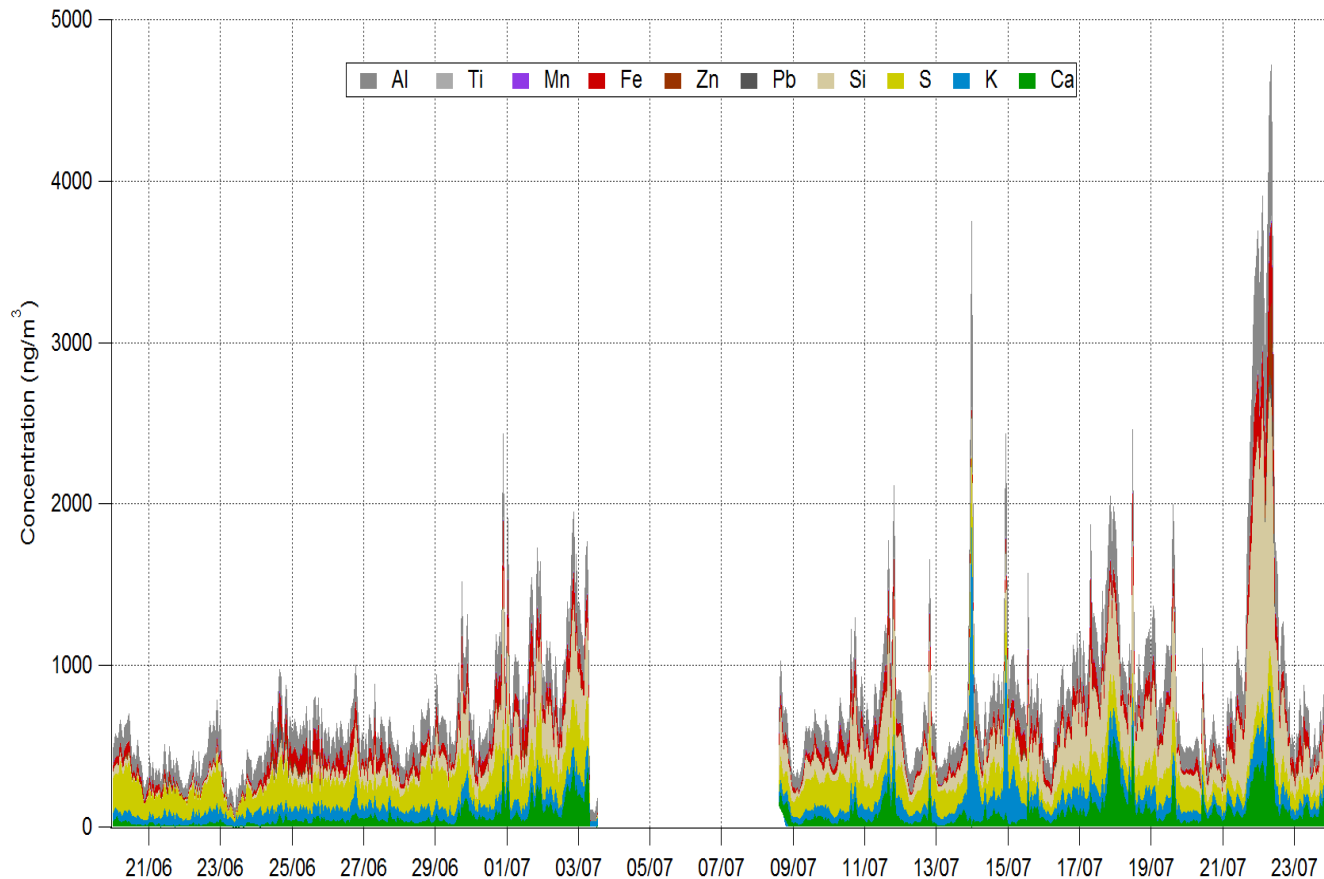
Ammonia

Metz – Borny station: Urban background measurements within Metz metropolitan area



Test of the PX-375 between 21/06/2015 and 25/07/2015

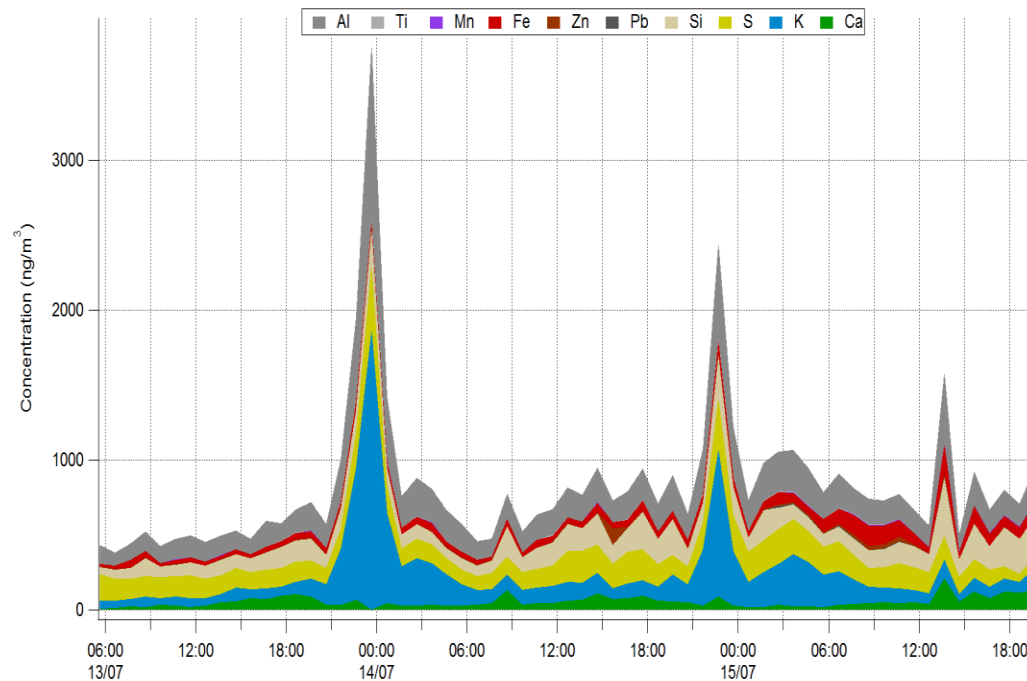
1-h resolution



Metz – Borny station: Urban background measurements within Metz metropolitan area



Test of the PX-375 between 21/06/2015 and 25/07/2015

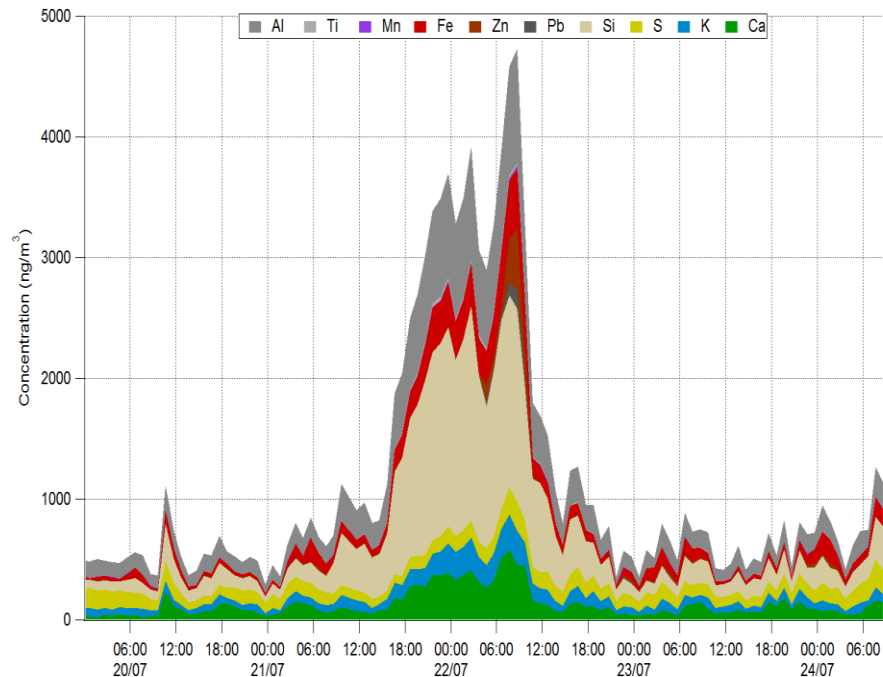


During the nights of 13/07 and 14/07, peaks of K observed, related to fireworks

Metz – Borny station: Urban background measurements within Metz metropolitan area



Test of the PX-375 between 21/06/2015 and 25/07/2015



Unpredicted episode, dominated by Si, and Al & Ca in a lesser extent.

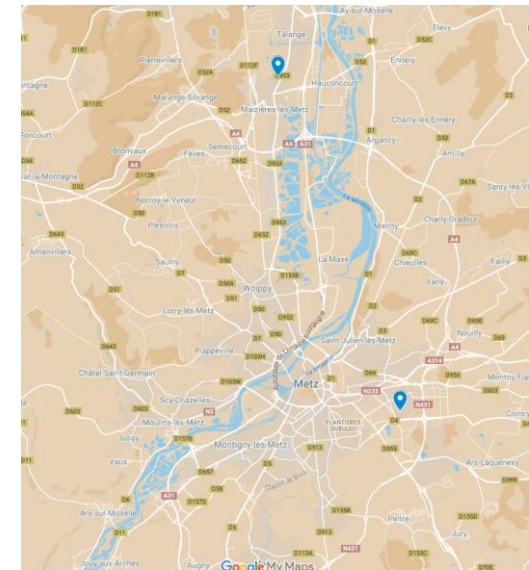
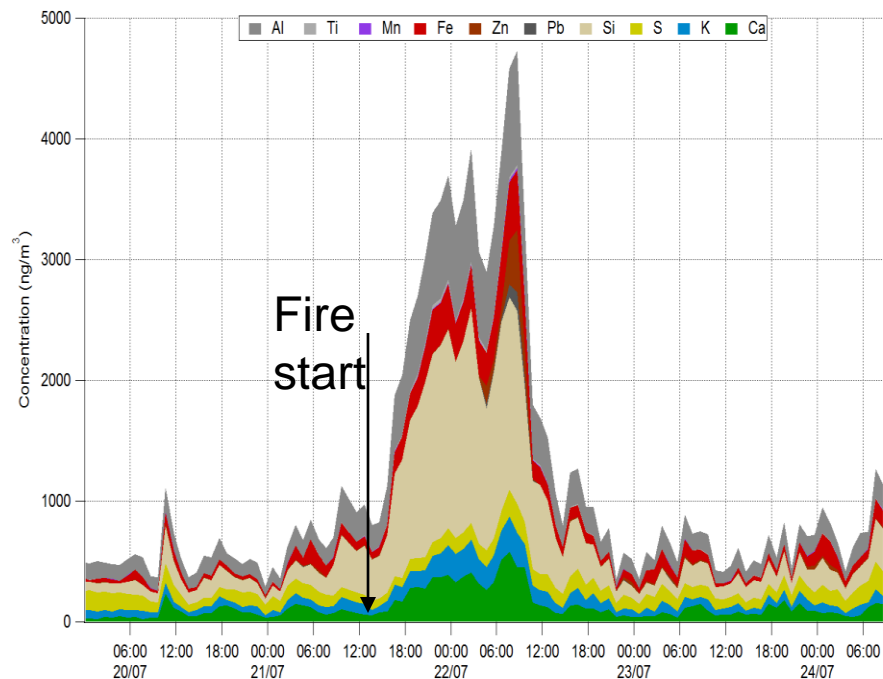
Clear peak of Fe, Zn, Pb on July 22nd at 08h00.

Concomittant increase of Black carbon concentrations, reaching 6 $\mu\text{g}/\text{m}^3$ in the middle of the night...

Metz – Borny station: Urban background measurements within Metz metropolitan area



Test of the PX-375 between 21/06/2015 and 25/07/2015



Heavy fire in a warehouse in Maizières les Metz, about 13km NNW of monitoring station.

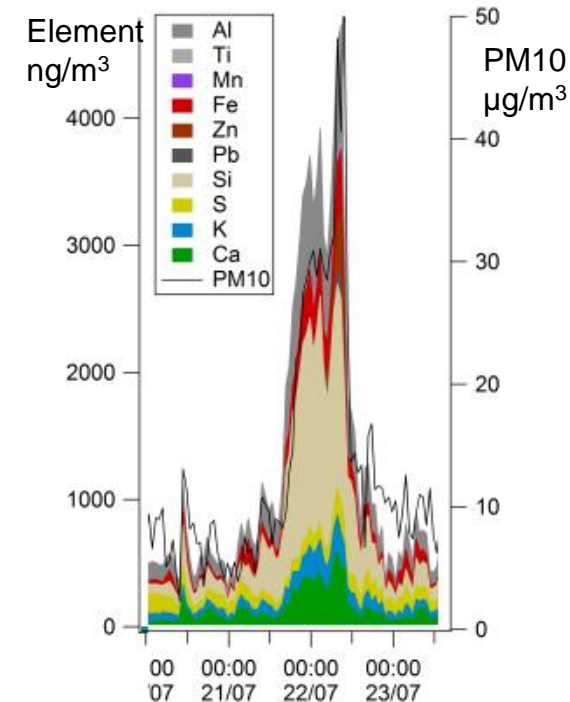
Low wind speeds during the night disabled the good dispersion of pollutants.

Maizières les Metz Large fire of waste disposal

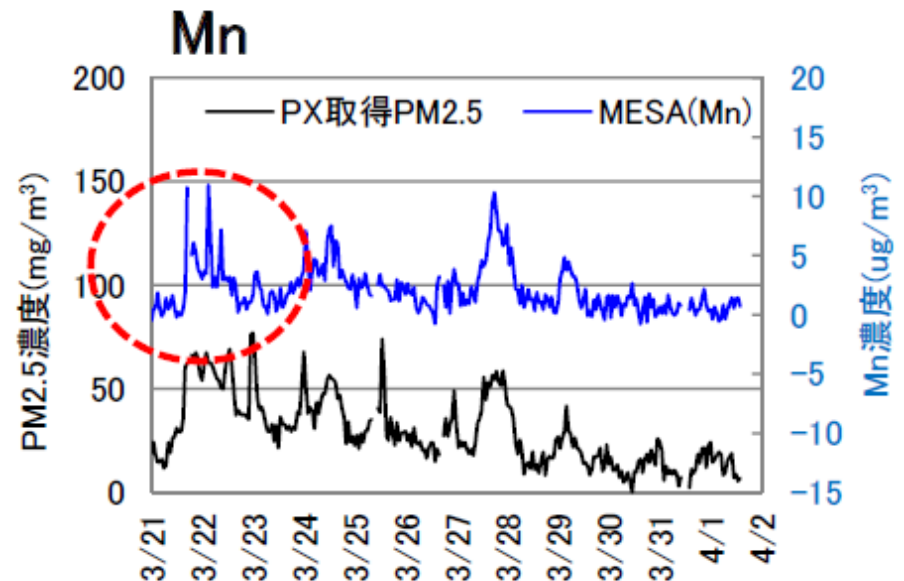
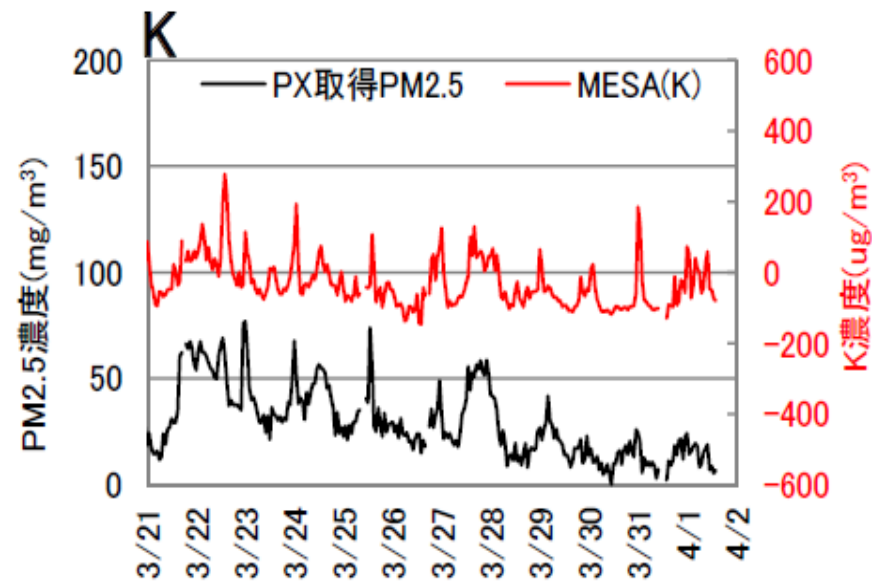
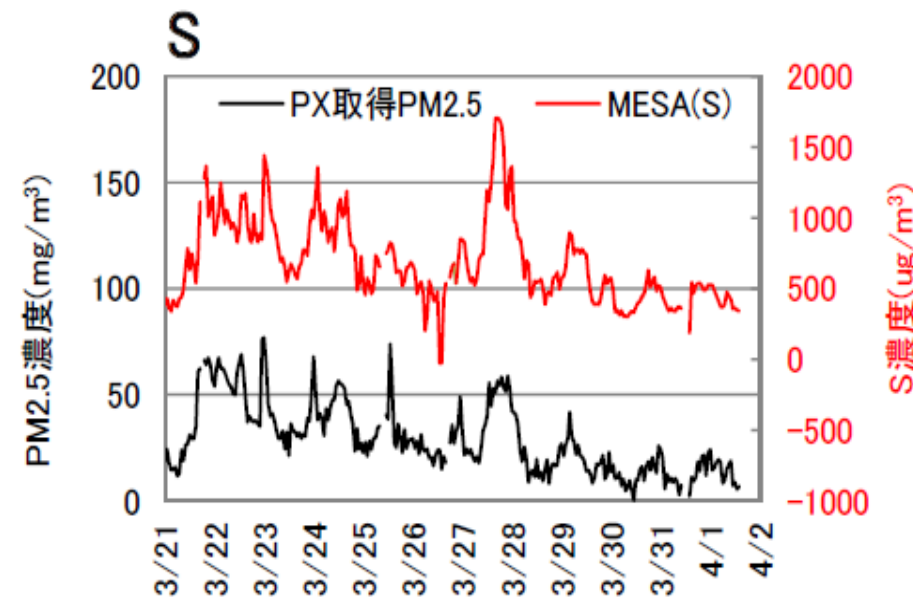
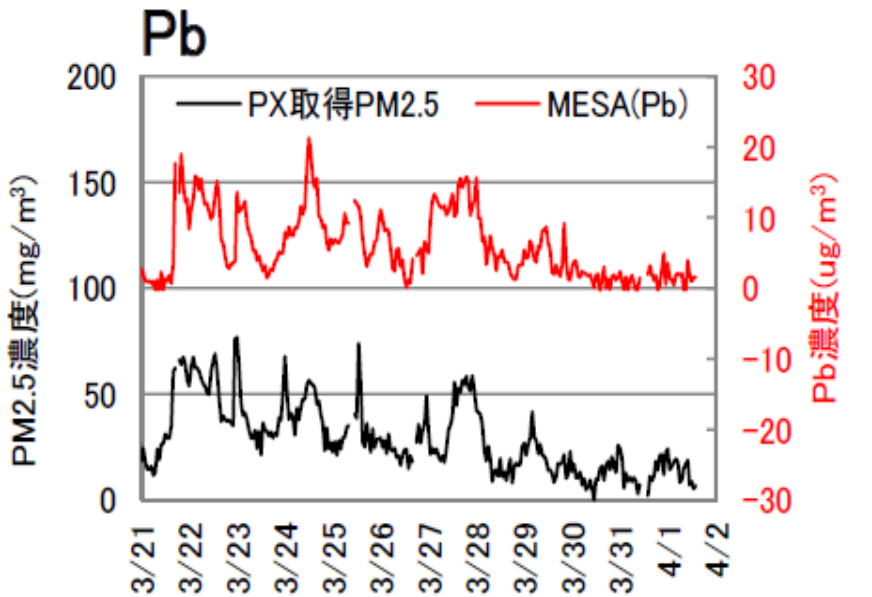
Start of fire july 21st at around 3PM

Warehouse dedicated to the stocking and recycling of metallic wastes, such as electronic devices, batteries and scrap iron, fridges, washing machin..., burned.

500 people concerned (300 moved to friends, 130 stayed)



Asia results



Source Apportionment Studies

1. Chemical Mass Balance (CMB)
2. Positive Matrix Factorization (PMF)

	Required data	Advantage	Disadvantage
C M B	<ul style="list-style-type: none"> • Elemental composition • Elemental source database 	One spot allows estimation of source	Need source matrix (data base of element compositions)
P M F	Elemental composition	No elemental source database needed	Need elemental composition for many measurement spots

Source Apportionment Studies

	Sea Salt Particle	Soil	Road dust	Vehicle Emission	Particle<Brake>	Particle<Tire wear>	Steel manufacture	Oil Combustion	Waste incineration	Open burning
Na	○								○	
Al		○	○							
Si										
K									○	○
Ca		○	○				○			
Sc		○	○							
Ti		○	○		○		○			
V								○		
Cr							○		○	
Mn							○			
Fe			○		○		○			
Co										
Ni							○	○		
Cu					○		○		○	
Zn						○	○		○	
As									○	
Se										
Rb										
Mo										
Sb					○				○	
Cs										
Ba					○					
Pb										
Elemental Carbon				○				○		

Continuous Elemental PM Analyzer

PX-375

Questions ?



Thank you

Omoshiro-okashiku
Joy and Fun

감사합니다

Cảm ơn

ありがとうございました

Dziękuję

धन्यवाद

Grazie

Merci

谢谢

நன்ற

ขอบคุณครับ

Obrigado

Σας ευχαριστούμε

اشكر

Tack ska ni ha

Danke

Большое спасибо

おもしろおかしく
ありがとうございます

眞峰

