Design and functionalities of the NanoMONITOR monitoring station prototype

… the environmental link …

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Foundation of the Valencian Govermment

Mediterranean Center for Environmental Studies (CEAM)

Program: METEOROLOGY AND ATMOSPHERIC POLLUTION

Area: METEOROLOGY AND POLLUTANT DYNAMICS

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Presentation outline.

I. The particulate matter environmental scenario.

II. Motivation and objectives.

III. General specifications.

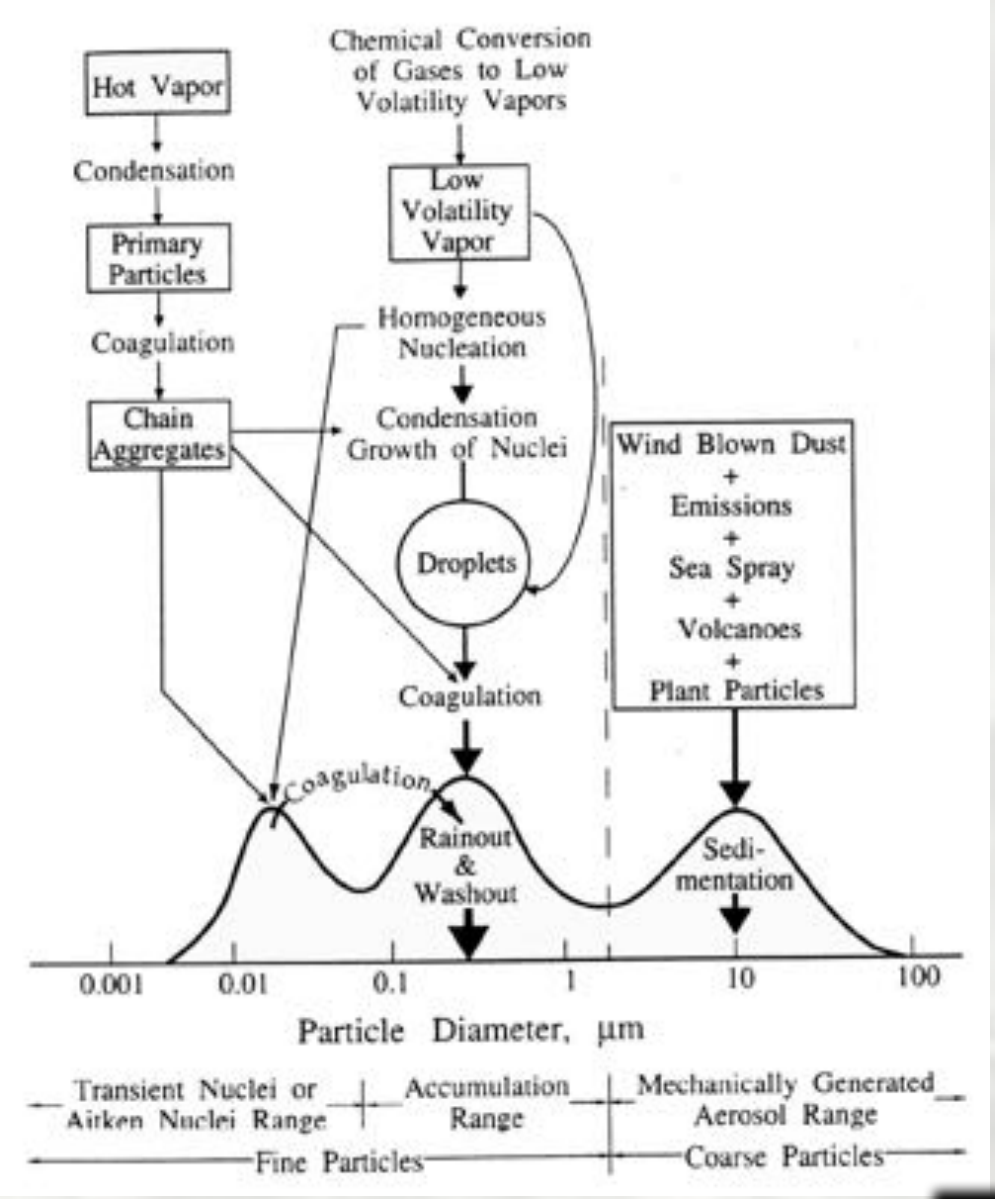
IV. Under construction.

V. Preliminary experimental approach.

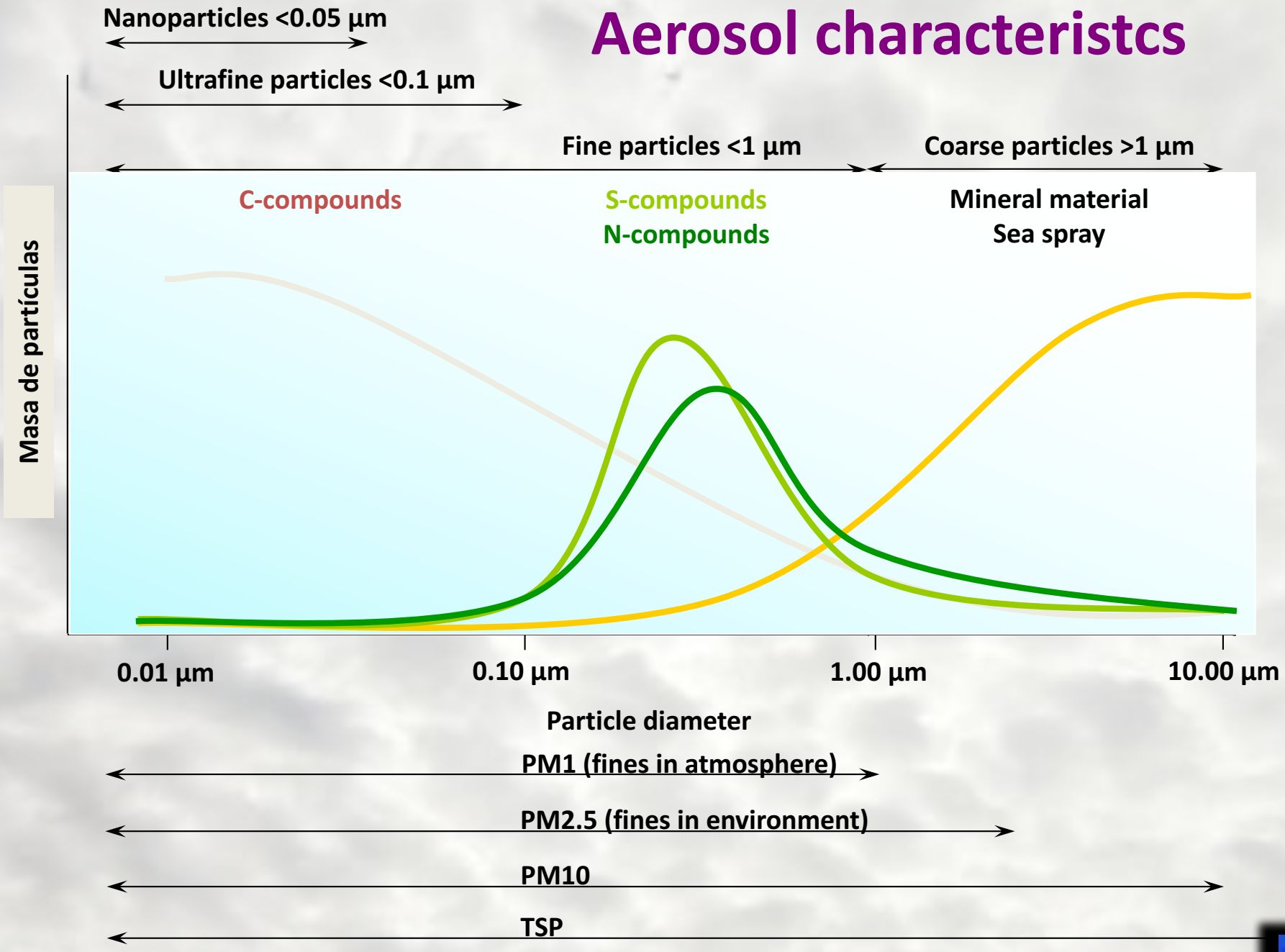
¿Why is particulate matter in the atmosphere of environmental interest?

- **Health impact.**
- **Ecosistems impact.**
- **Climatic change**
- **Material degradation.**
- **Visibility dismishing**

Aerosol characteristcs



Aerosol characteristcs



PARTICLE DEPOSITION IN LUNGS

¿possible effects of particulatte matter in lungs?

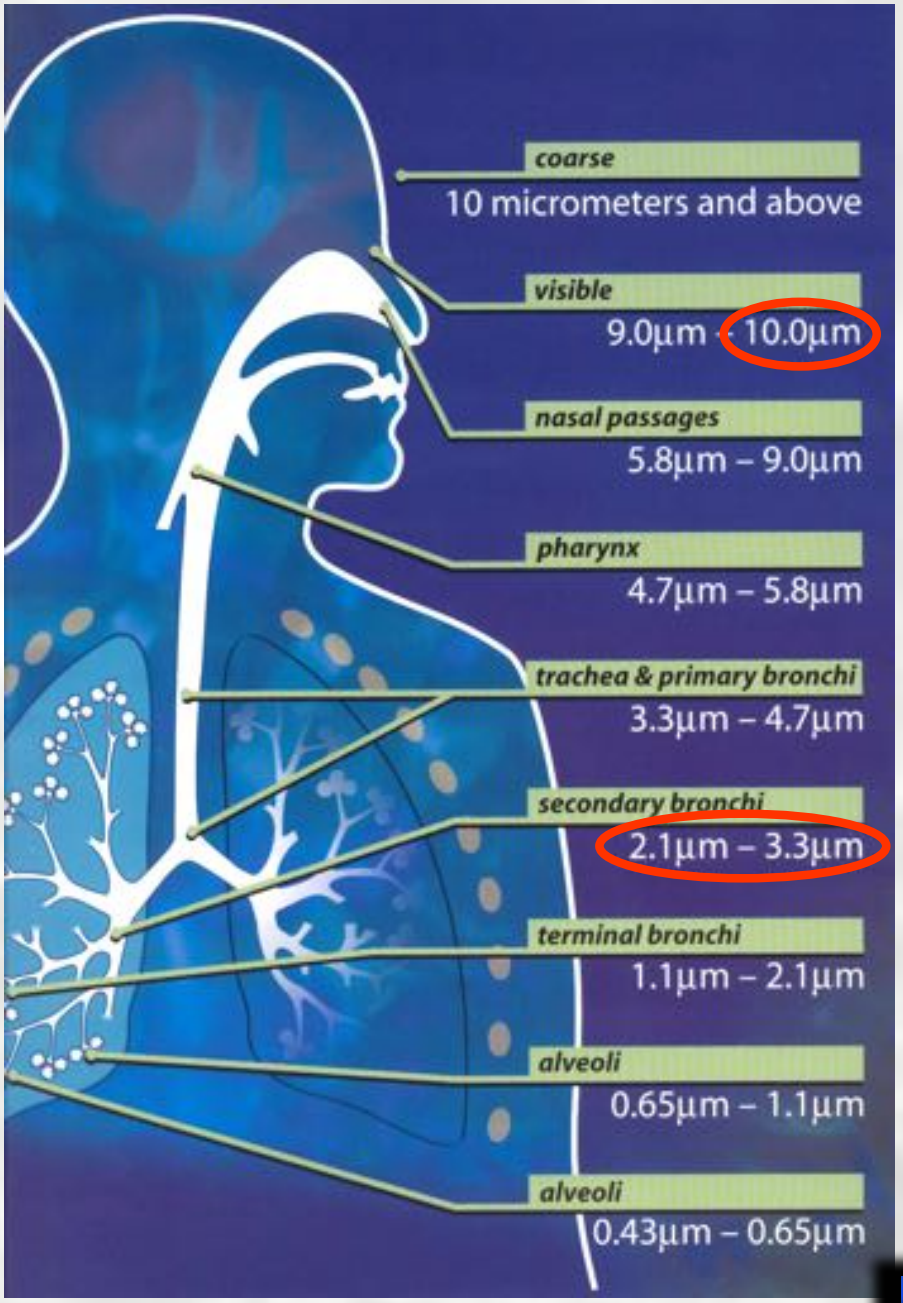
activate protection mechanisms

transitory answer (e.g. asmathic attack)

long term epitelial damage

fibrosis

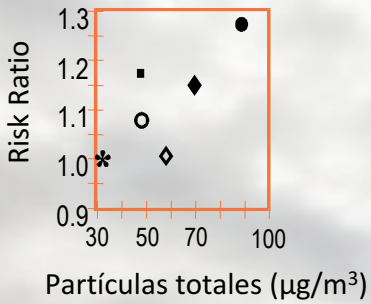
tumors



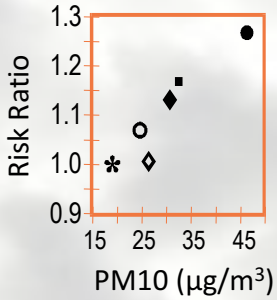
HEALTH IMPACT

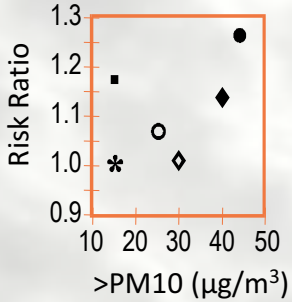
(US EPA, 1996)

Partículas totales

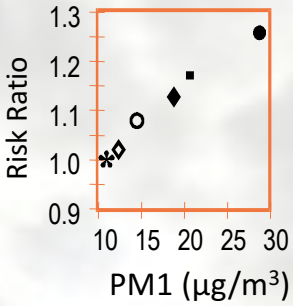


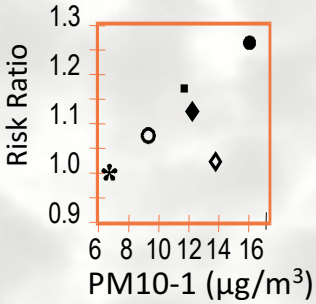
PM10 y >PM10



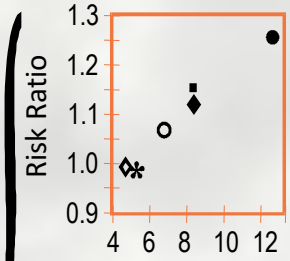


PM1 y PM10-PM1

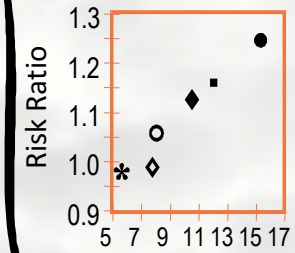




SO_4^{2-} en PM1

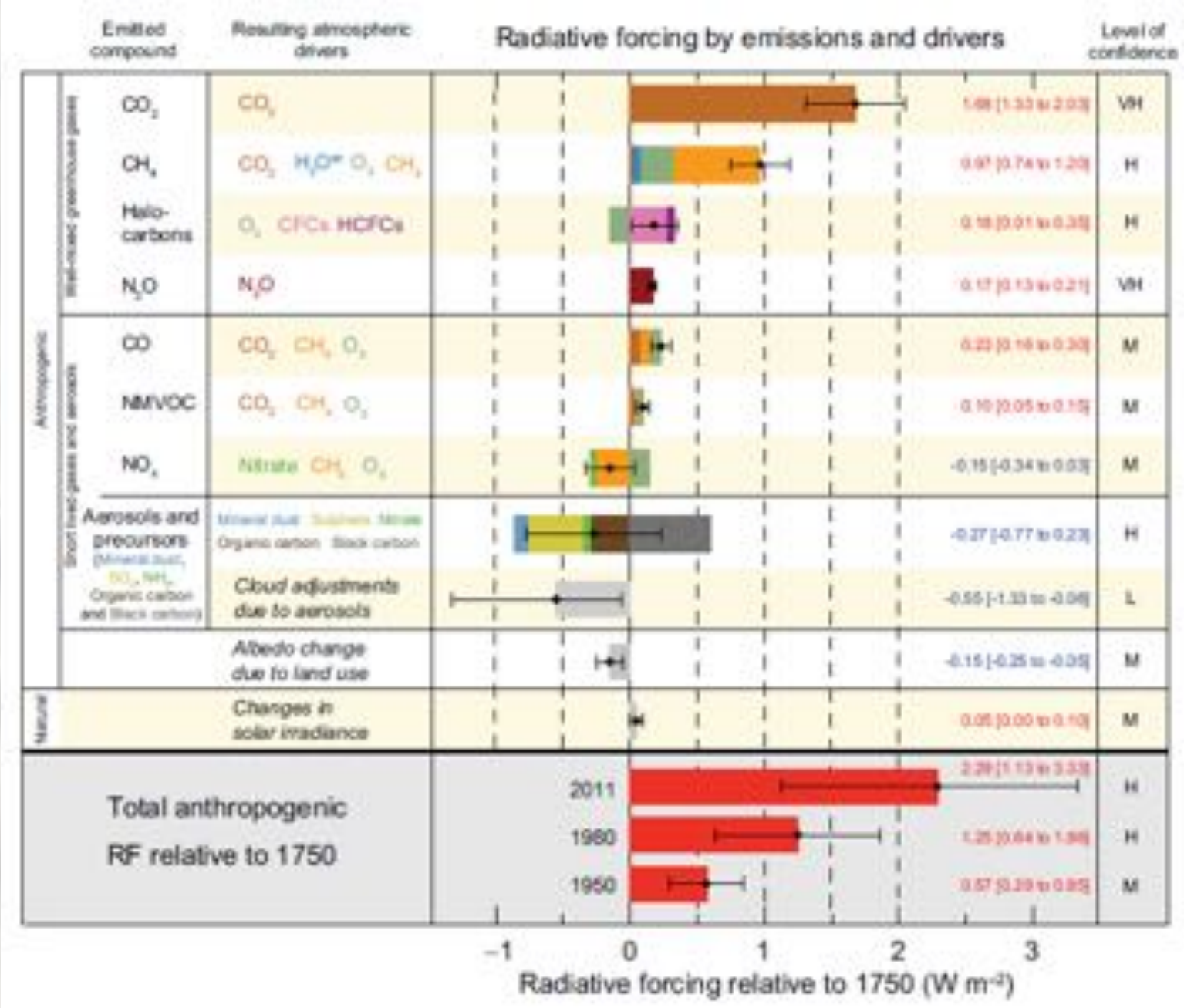


SO_4^{2-} en PM1 (µg/m³)



No SO_4^{2-} en PM1
en PM1 (µg/m³)

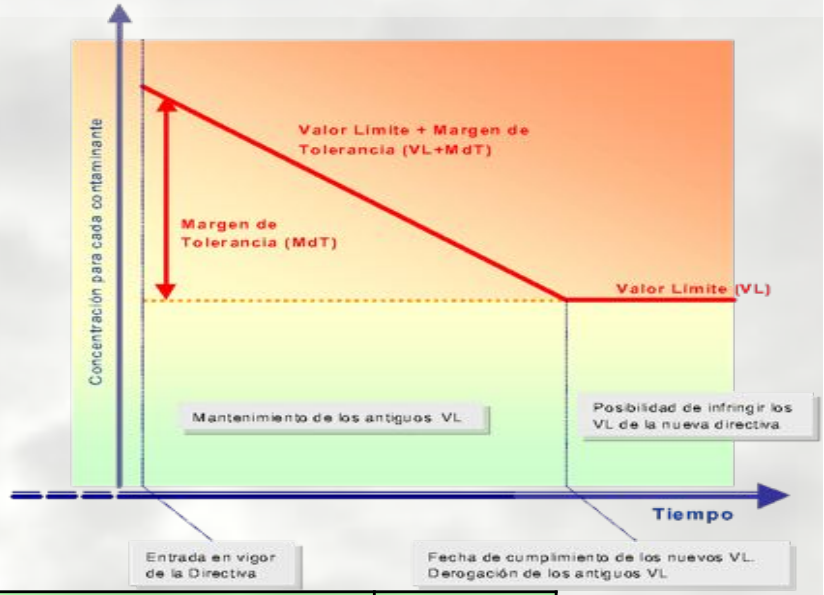
I The particulate matter environmental scenario



... From a legal perspective ...

Directive 2008/50/CE of the European Parliament and of the Council of 21 May 2008 on ***ambient air quality and cleaner air for Europe***.

Real Decreto 102/2011, of the Spanish Parliament of 28/Jan 2011 on ***the improvement of air quality***.



Contaminants Considered :

Pollutant	Estate	Pollutant	Estate
Dióxido de Azufre (SO_2)	Gas	Dióxido de Nitrógeno (NO_2)	Gas
Ozone (O_3)	Gas	Monóxido de Carbono (CO)	Gas
Atmospheric particles: **PM10** **PM2.5**	**Particle**	Organic Volatil Compounds (VOC): Bencene	Gas
Amonna (NH3)	Gas	Mercurio (Hg)	Gas
Metals: Plomo (Pb) Arsénico (As) Cadmio (Cd) Níquel (Ni)	Particle	Others: Cloro molecular (Cl_2) Cloruro de hidrógeno (HCl) Compuestos de flúor Fluoruro de hidrógeno (HF) Sulfuro de hidrógeno (H_2S) Sulfuro de carbono (CS_2)	Gas
Policiclic Aromatic Hidrocarbons (HAP): Benzo(α)pireno (B(α)P)	Particle		

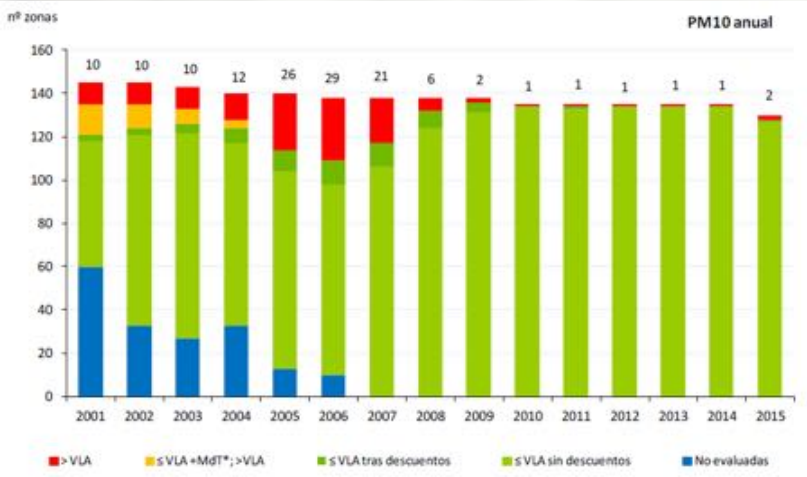
… From a legal perspective …

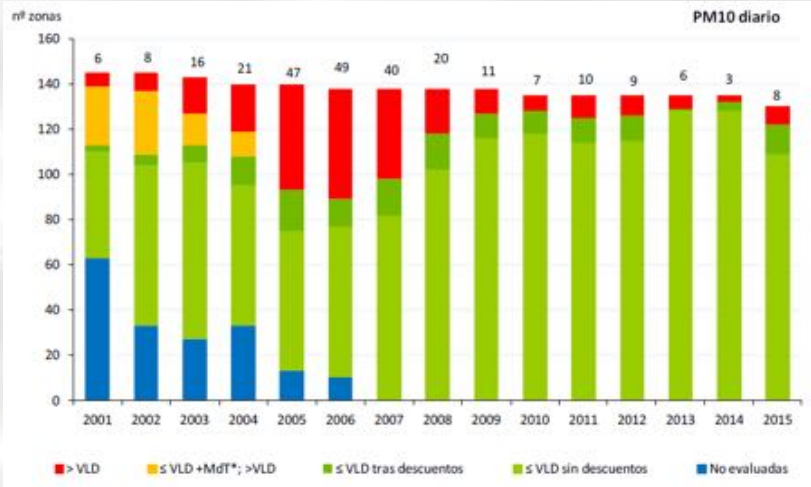
Compound	Protection	Parameter	Threshold	Reference Method
PM10	health	daily average	**50 µg/m^3**, *not to be exceeded more than **35** times a calendar year*	gravimetric (EN12341:199)
		annual average	**40 µg/m^3**	
PM2.5	health	annual average	**25 µg/m^3**	gravimetric (EN14907:2005)

... surveillance networks ...

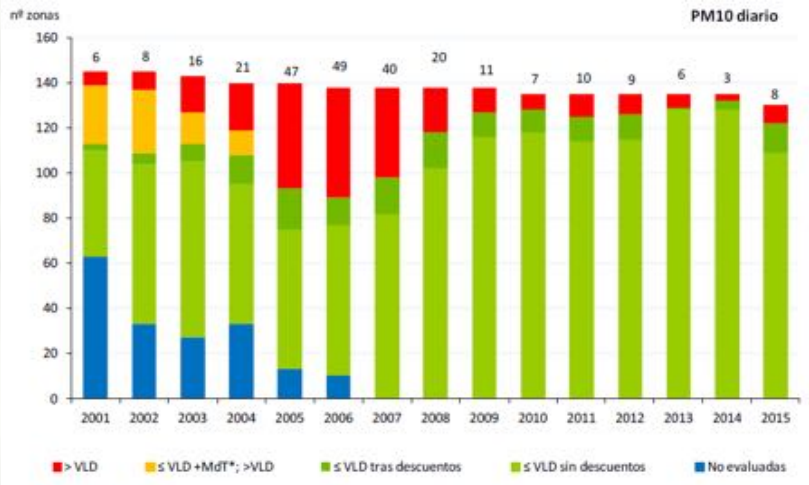
... the national state of air quality ...

PM10: annual limit; daily limit;

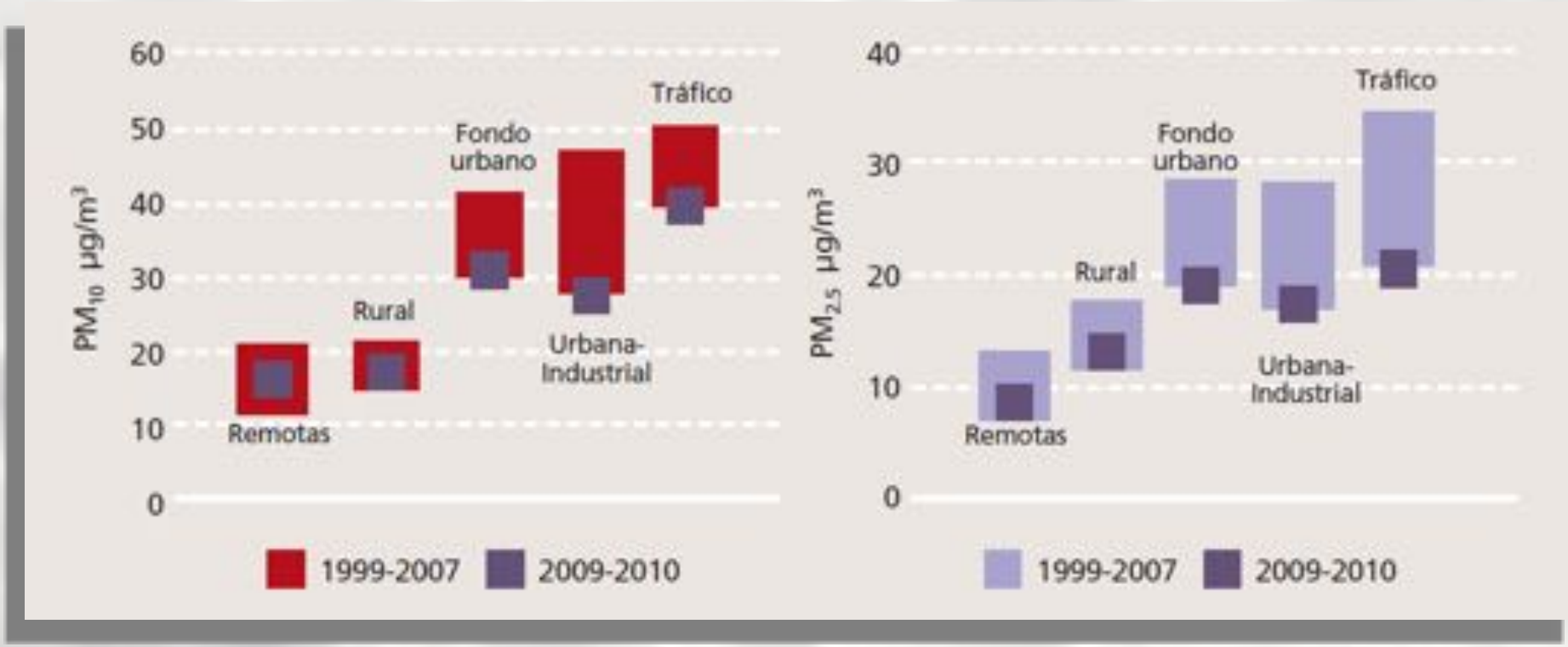




PM2.5: annual limit;

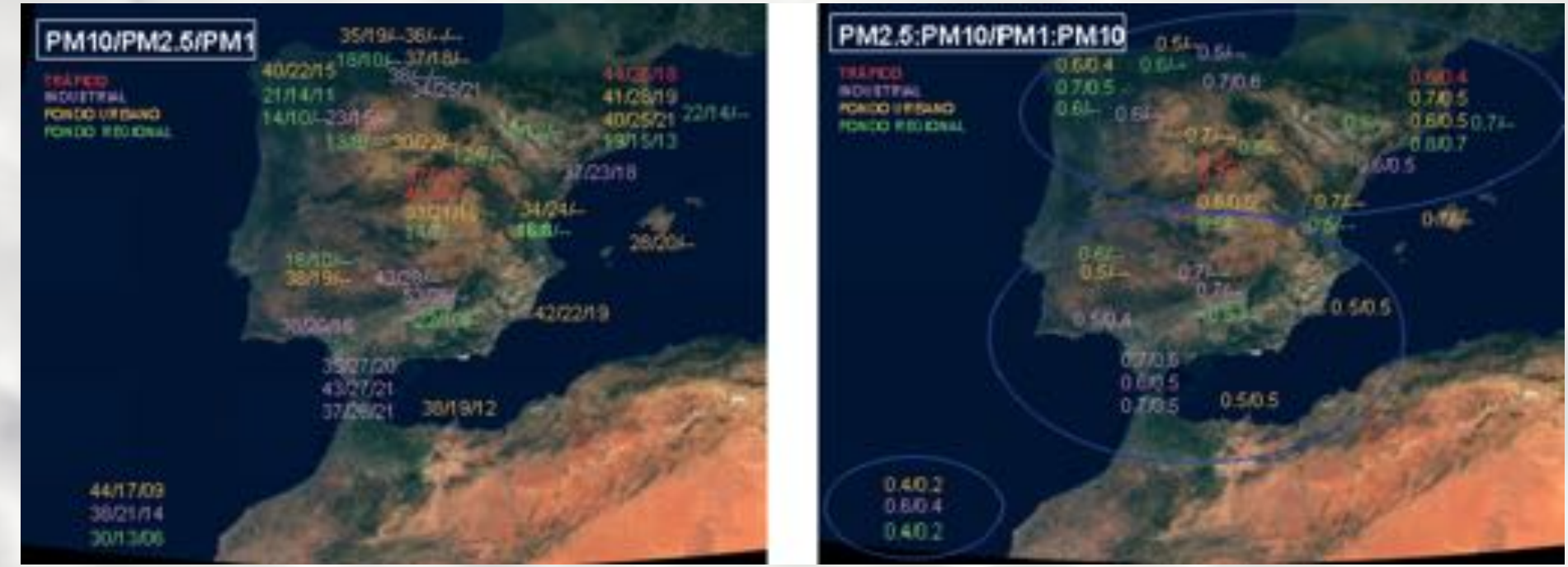


I The particulate matter environmental scenario



Normal PM10/PM2.5 concentrations in remote (EMEP), rural, background urban, urban-industrial and hotspot-traffic stations.

I The particulate matter environmental scenario



Average concentration of PM10/PM2.5/PM1for slected stations along the Iberian Peninsula depending site characteristics (left) and PM2.5/PM10, PM1/PM10 ratios (right)

Integrate/develop a practical tool that …

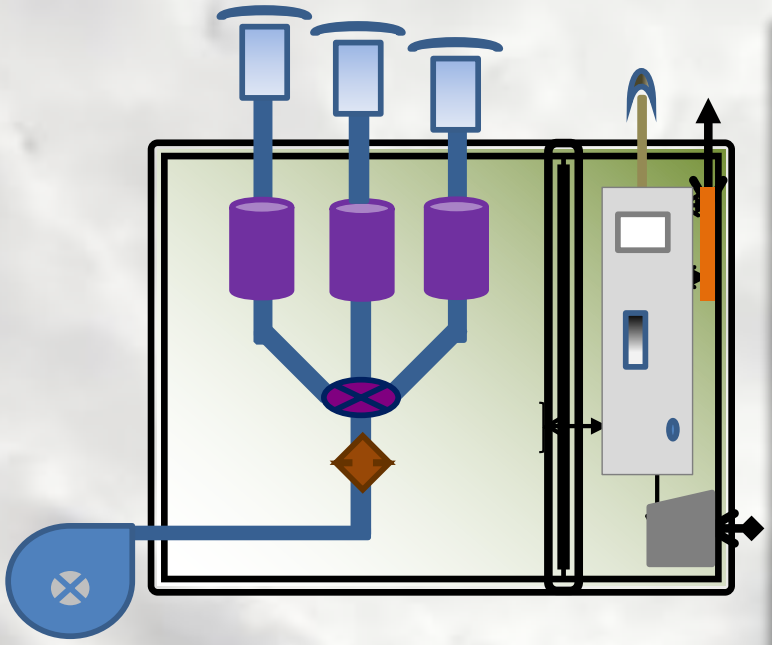
provide

- **useful information to support industrial needs, …**
- **support a connection with environmental world, …**
- **universalize information, …**

through

- ***… robust device, unattended and automatic use, remote access, outdoor protected, …***
- ***… nano-micro escales relationship …***
- ***… web difussion …***

III General specifications

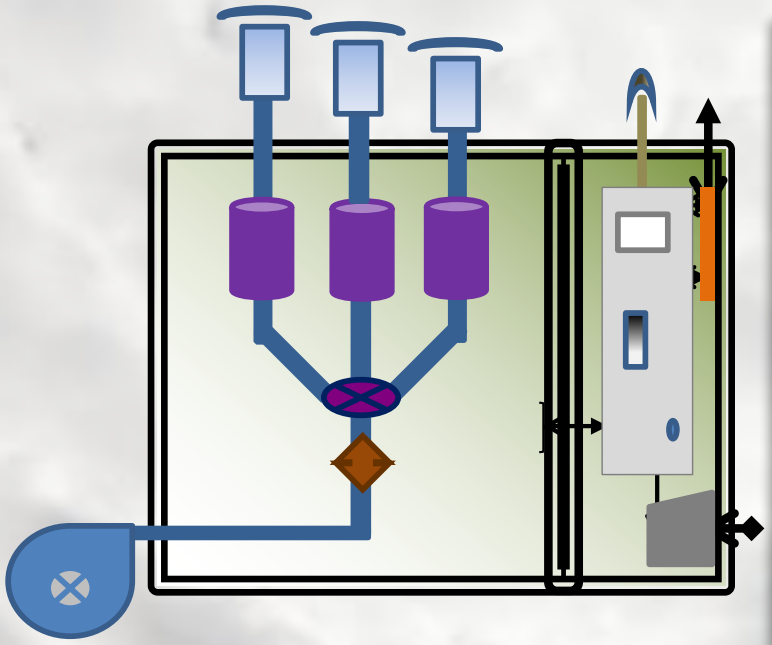


Generic capabilities.

Ultrafine particles:

- ✓ unattended continuous sampling, and digital storage, of environment ultrafine particle concentration/size levels;
- ✓ measurement and storage of atmospheric/thermodynamic quantities of the sample (temperature, humidity and pressure);
- ✓ storage of complementary magnitudes provided by the nanoparticle sensor suitable for indirect measurement control/evaluation;

III General specifications

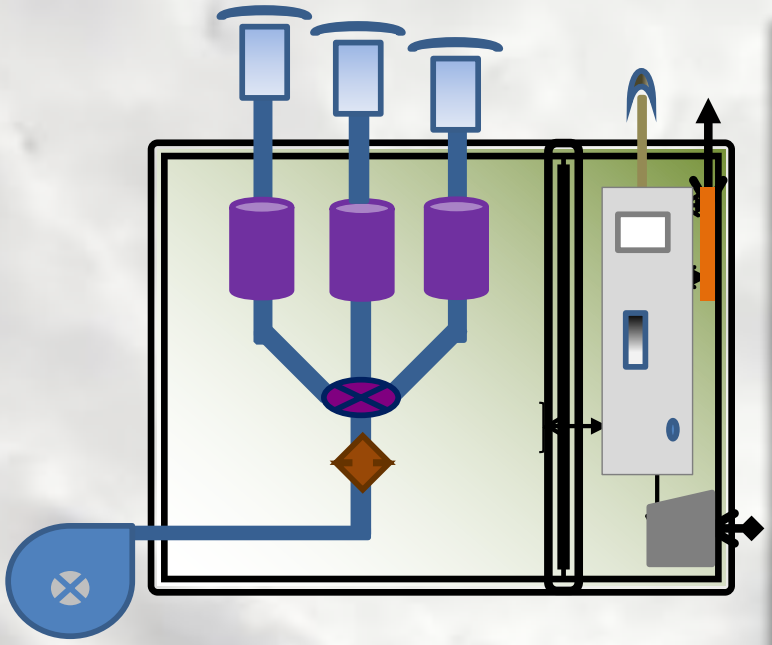


Generic capabilities.

Fine particles:

- ✓ filter capture of particulate matter (through 3 independent configurable lines), with sampling/flow characteristics storage;
- ✓ simultaneously or independently of the automatic measurements;
- ✓ modular design for interchangeable external heads and collecting systems (filters/impactors);

III General specifications



Generic capabilities.

Operation:

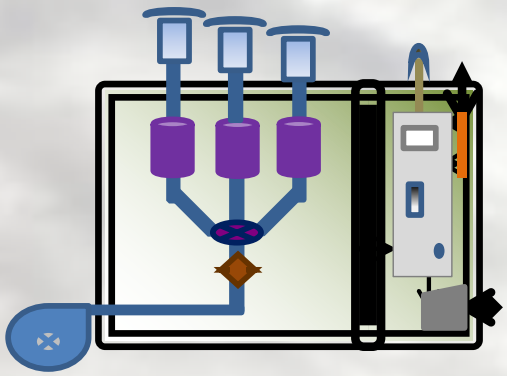
- ✓ user configuration of some operation/storage conditions;
- ✓ flexible scheduling of continuous monitoring an physical sampling;
- ✓ flow rate setting (in the range 0-30l / min);
- ✓ remote control of the equipment (operation and/or data recovery);
- ✓ real time dumping of automatic measurements (nanoparticles and sample characteristics) on a remote server;

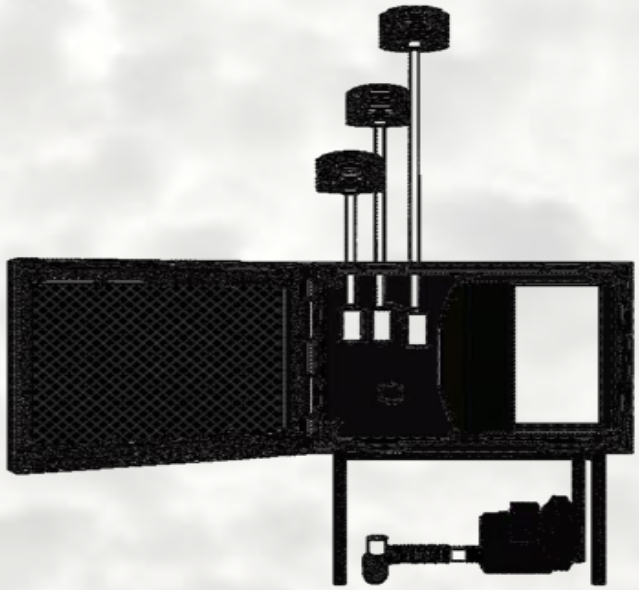
III General specifications

Generic capabilities.

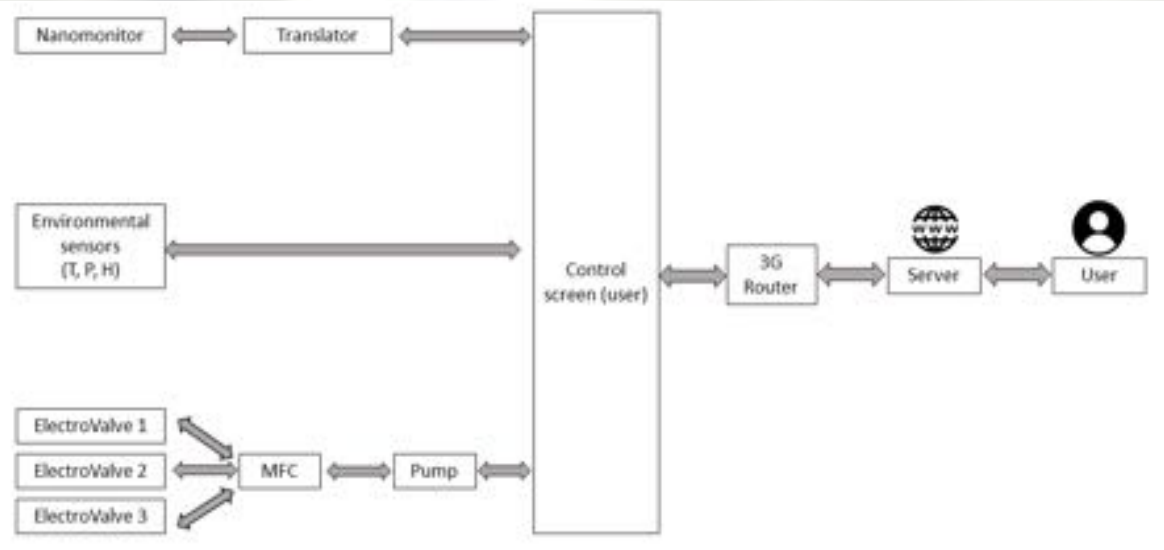
Physical integration:

- ✓ integration into a protected and portable structure;
- ✓ external removable pump;
- ✓ incorporation of a cooling system of the nanoparticle module.

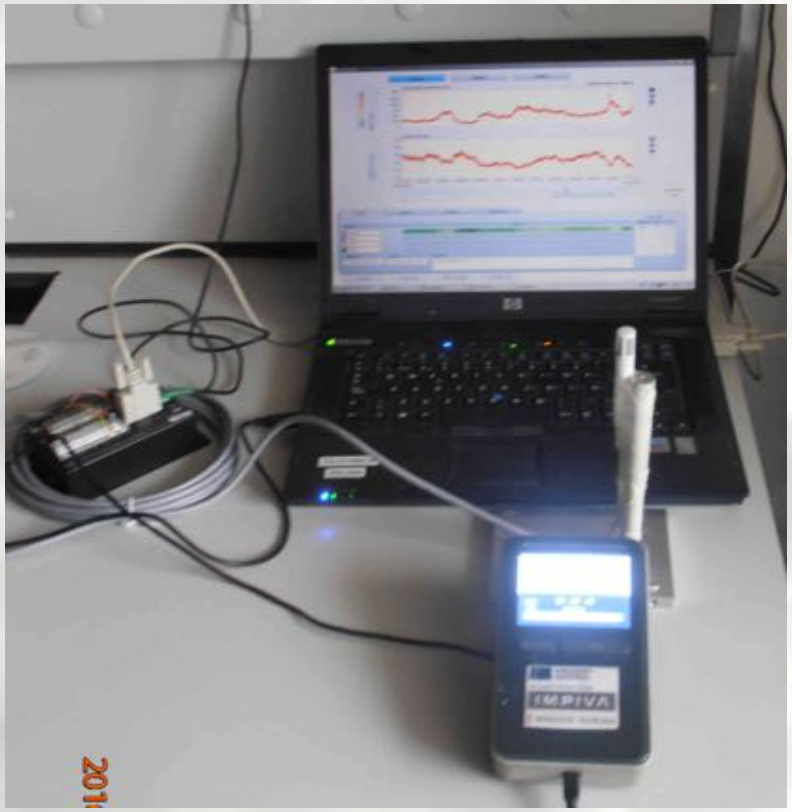




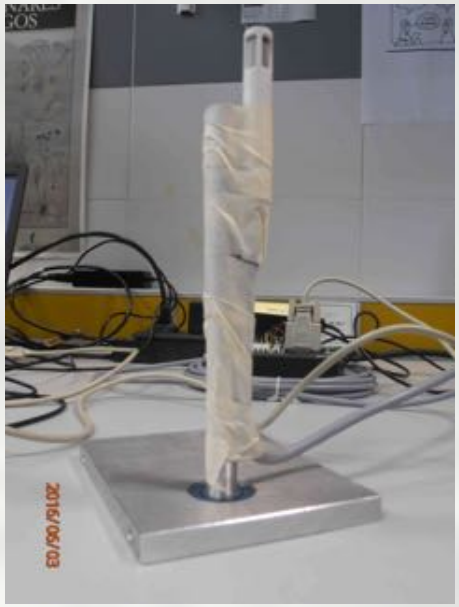
IV Under construction



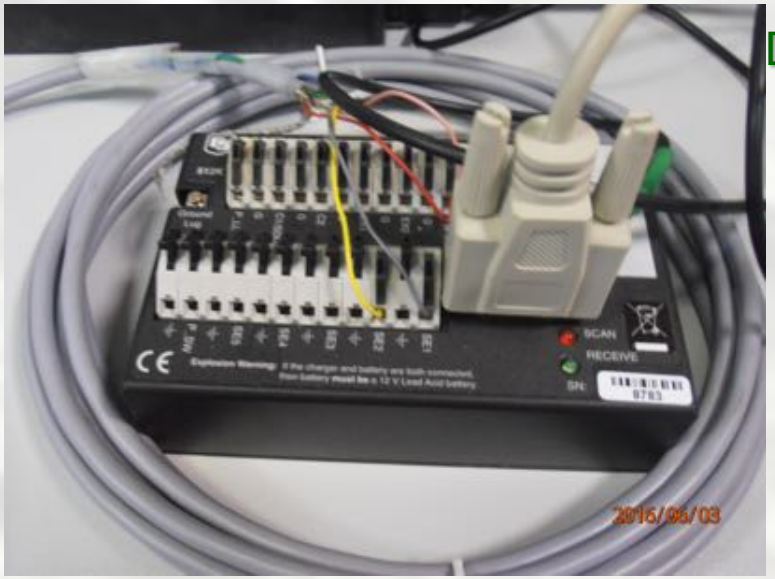
V Preliminary experimental approach



Nanosensor device and computer (data download and communication support)



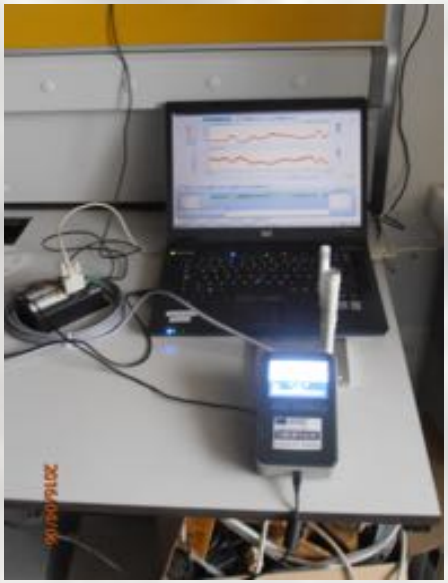
Temperature/humidity sensors

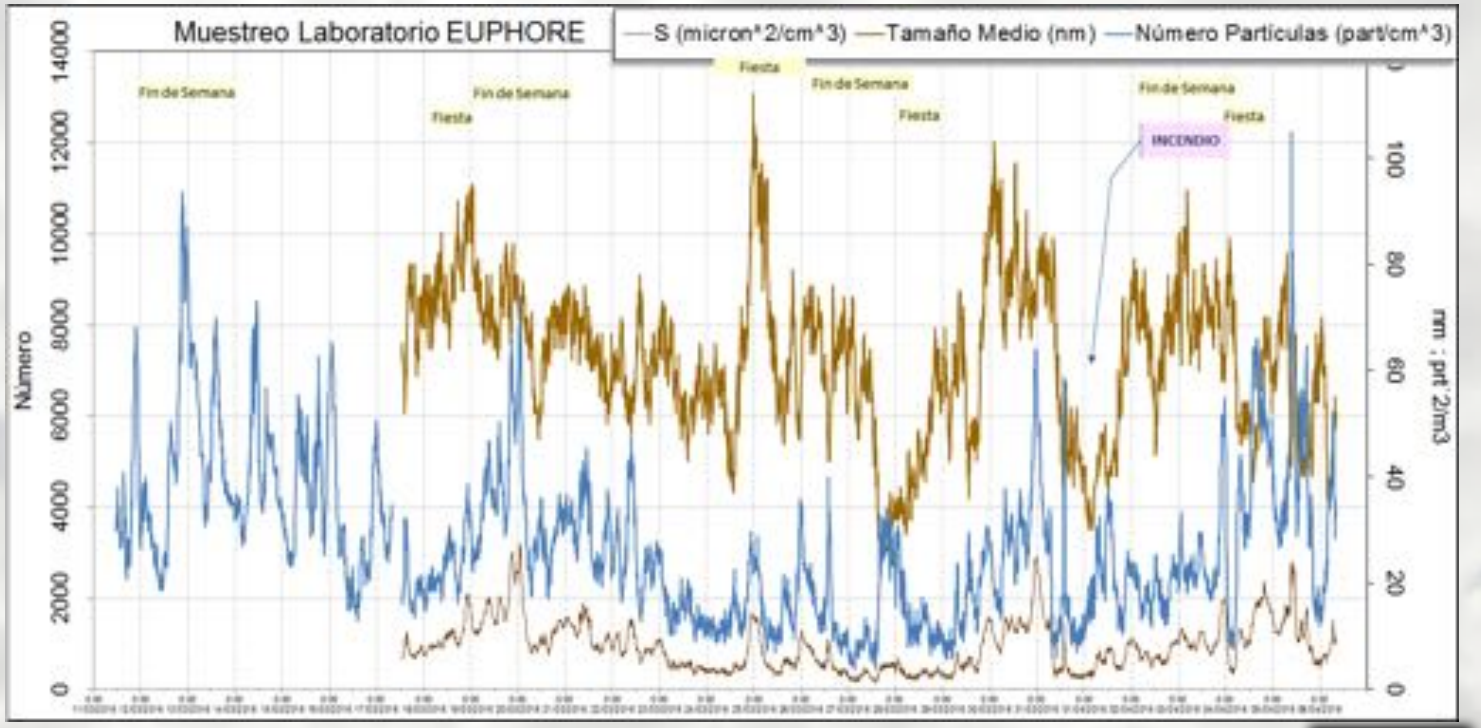


Datalogger

V Preliminary experimental approach

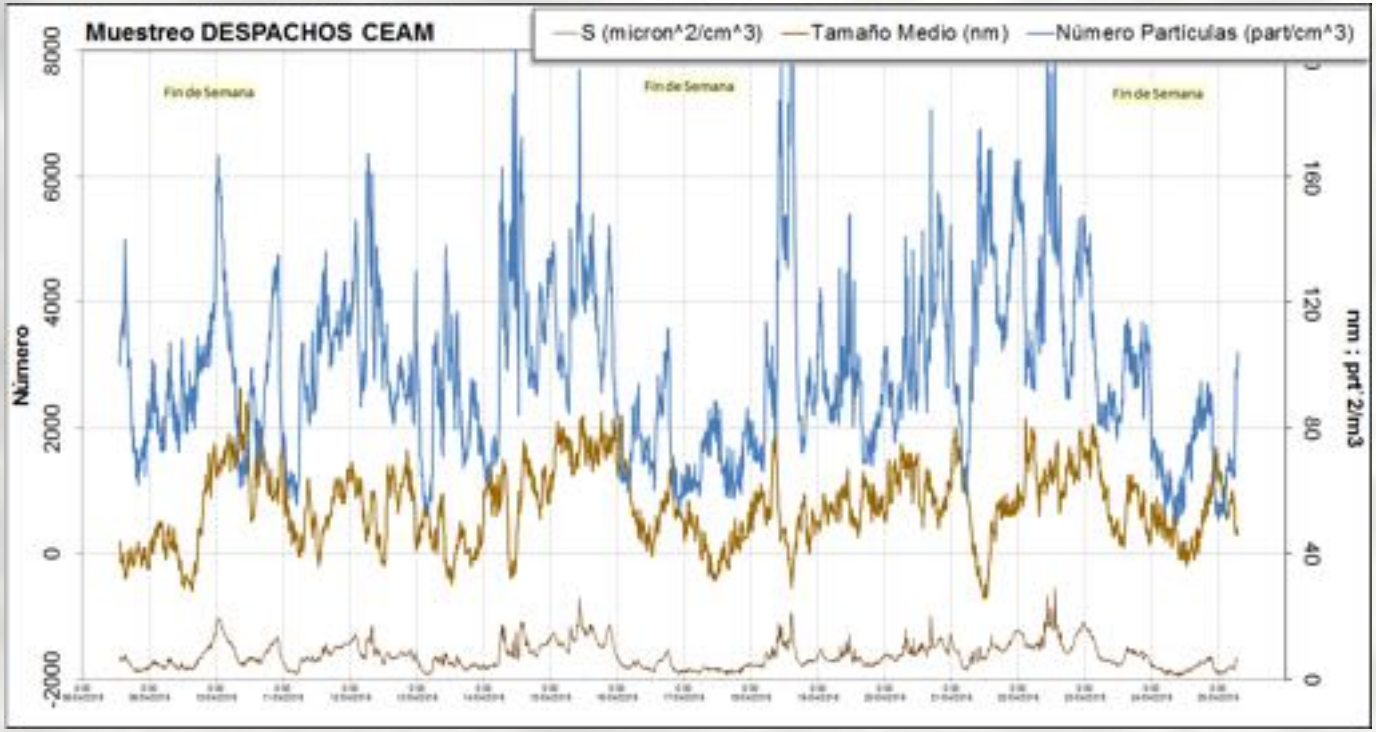
INDOOR: chemical laboratory (CEAM)





V Preliminary experimental approach

INDOOR: office (CEAM)



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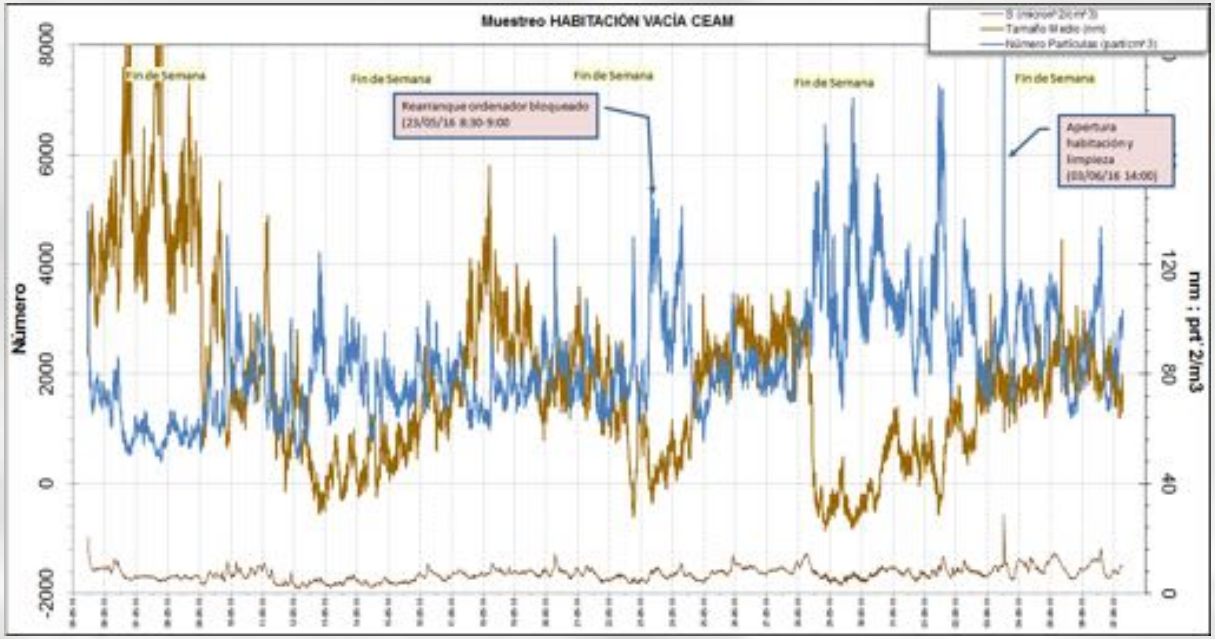
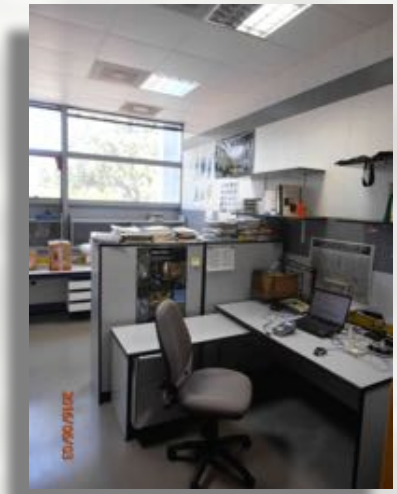


INDOOR: closed room (CEAM)



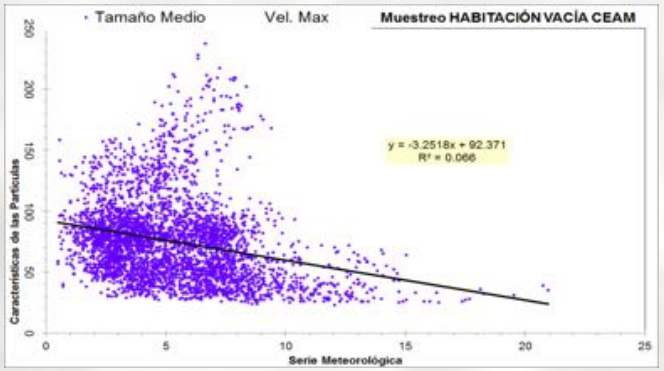
V Preliminary experimental approach

PARTICLE MEAN SIZE

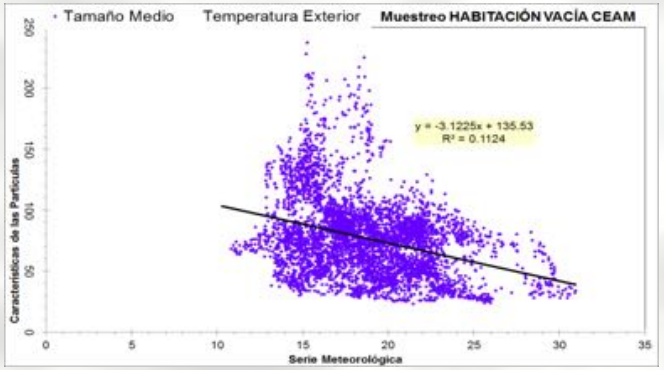
Outdoor

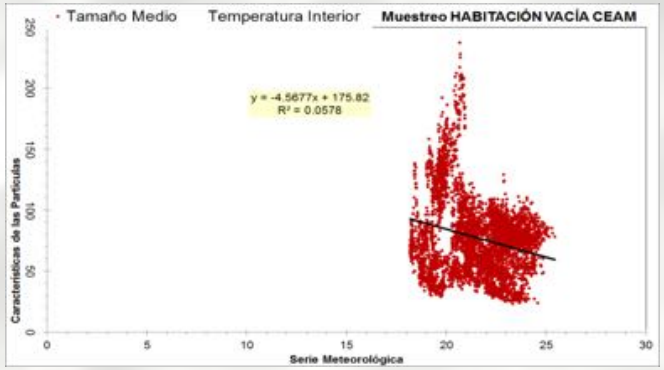
Indoor

Max. Speed

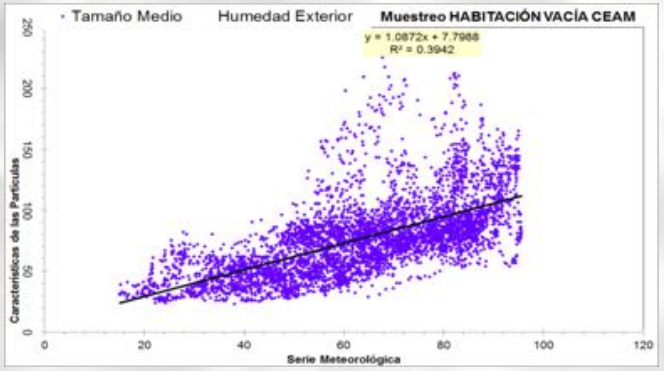


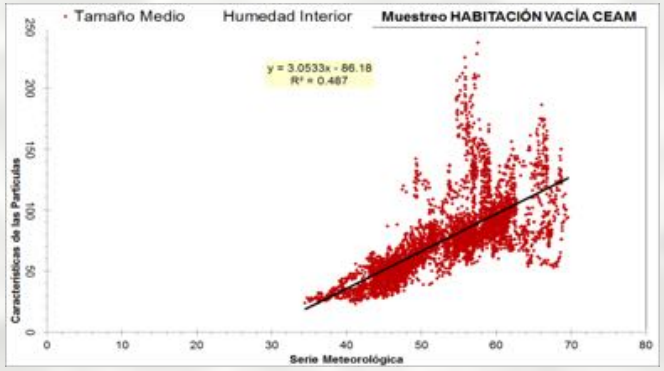
Temperature





Relative Humidity





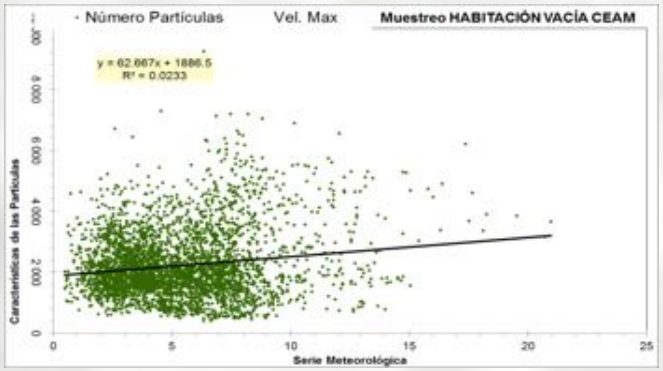
V Preliminary experimental approach

PARTICLE NUMBER

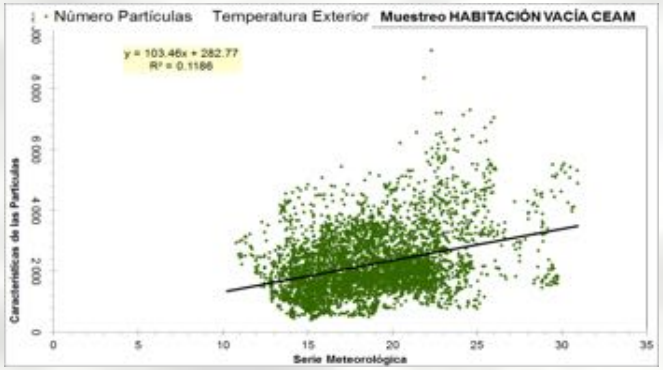
Outdoor

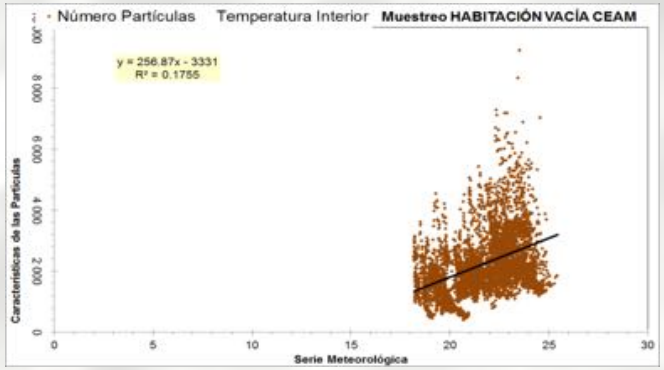
Indoor

Max. Speed

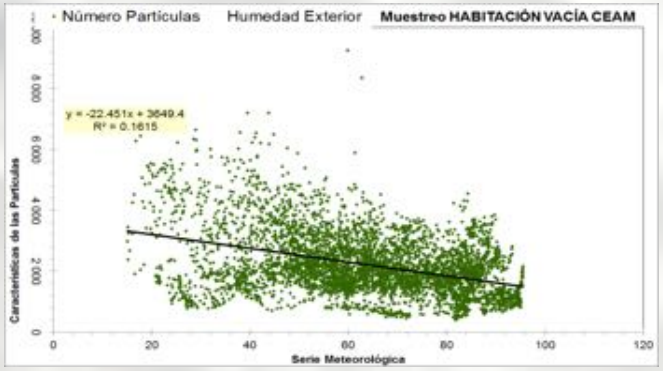


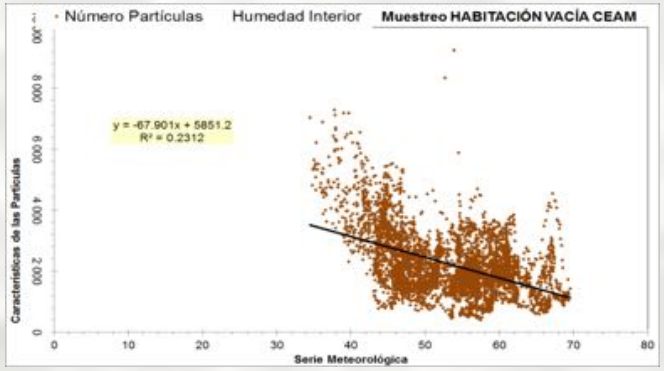
Temperature





Relative Humidity

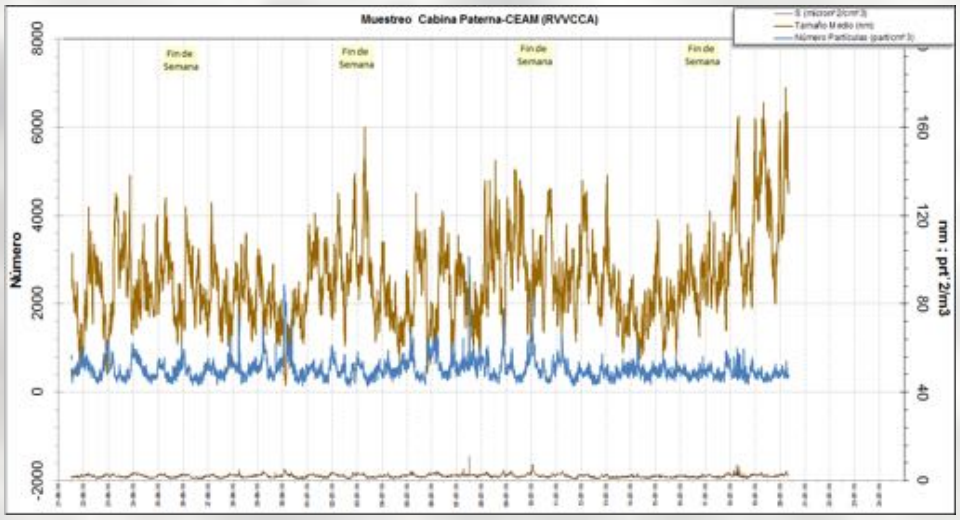




V Preliminary experimental approach

OUTDOOR:

air quality surveillance and control network



THANK YOU FOR YOUR ATTENTION