



# GRUPO “AR E ENERGIA” (GARE)

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Departamento de Ambiente  
e Departamento

[www.ua.pt/dao](http://www.ua.pt/dao)



**RESEARCH@DAO**



# Members working in the field of atmospheric chemistry



CÉLIA

**Principal  
researcher**



TERESA



MÁRIO

**Professors**



ANA

**Junior  
researcher**

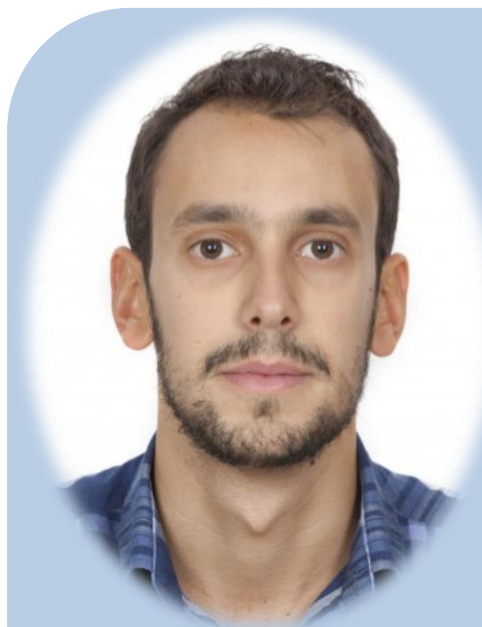


MARGARITA



ESTELA

**Postdoctoral  
fellows**



ISMAEL



DANIELA



LEONARDO



YAGO

**PhD  
students**

**Project  
scholarship  
holder**



MARLENE



# Research topics

1. Indoor air quality
2. Outdoor air quality & source apportionment
3. Characterisation of emissions:
  - a. Wildfires
  - b. Residential biomass combustion
  - c. Cooking
  - d. Traffic – exhaust and non-exhaust
4. Toxicology of particulate matter
5. Emission/deposition fluxes of GHG



# 1. Indoor air quality

- **Comfort parameters/Ventilation rates**

- CO, CO<sub>2</sub>; Temperature and Relative Humidity

- **Passive sampling**

- NO<sub>2</sub>, O<sub>3</sub>, VOCs, Carbonyls, Radon

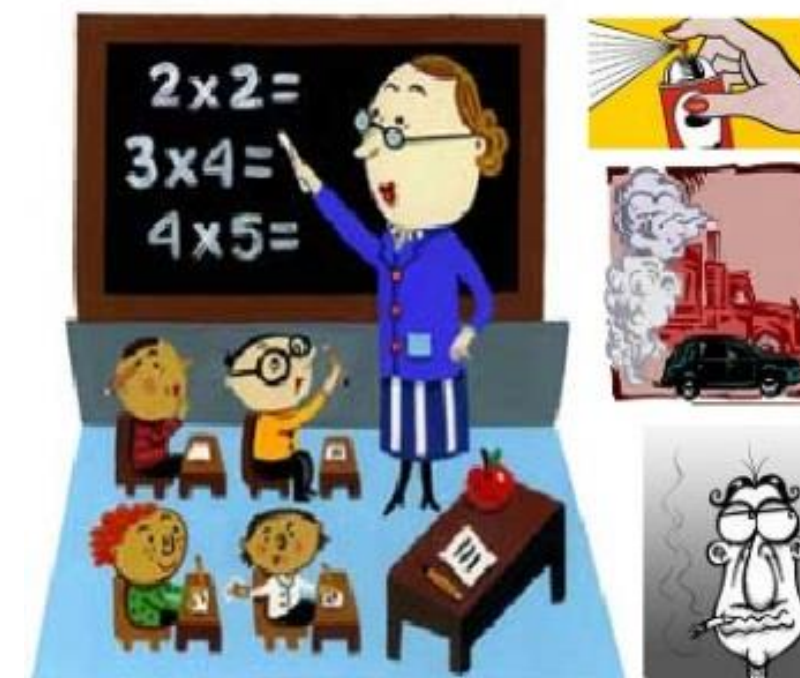
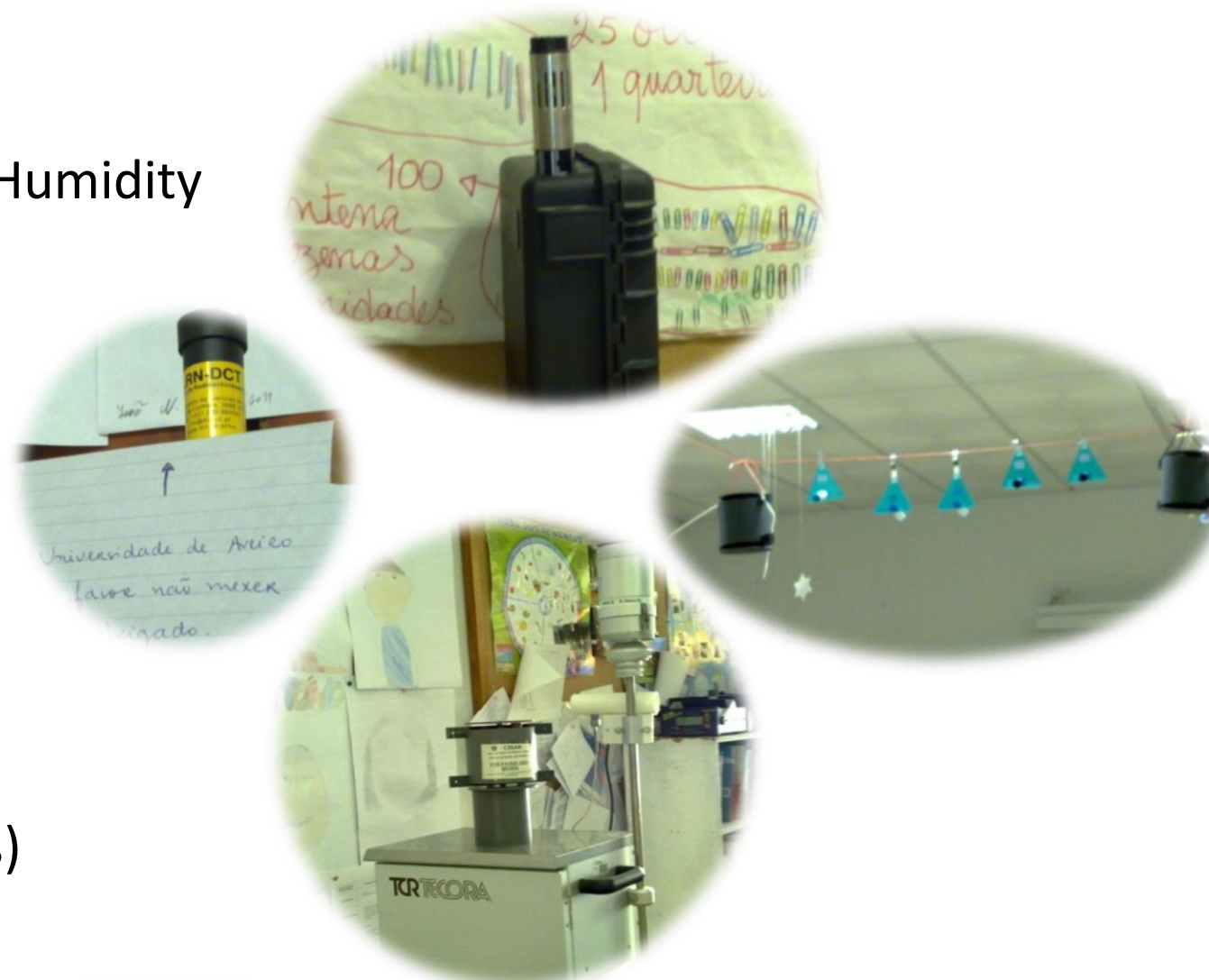
- **Particulate matter**

- PM<sub>1</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>

- (gravimetric and optical techniques)

- **Microorganisms**

- Bacteria and Fungi



Indoor Air Quality in  
Primary Schools



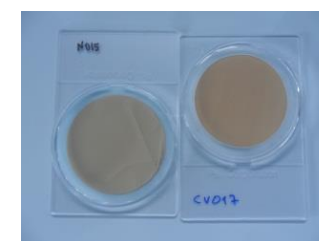


## 2. Outdoor air quality & source apportionment

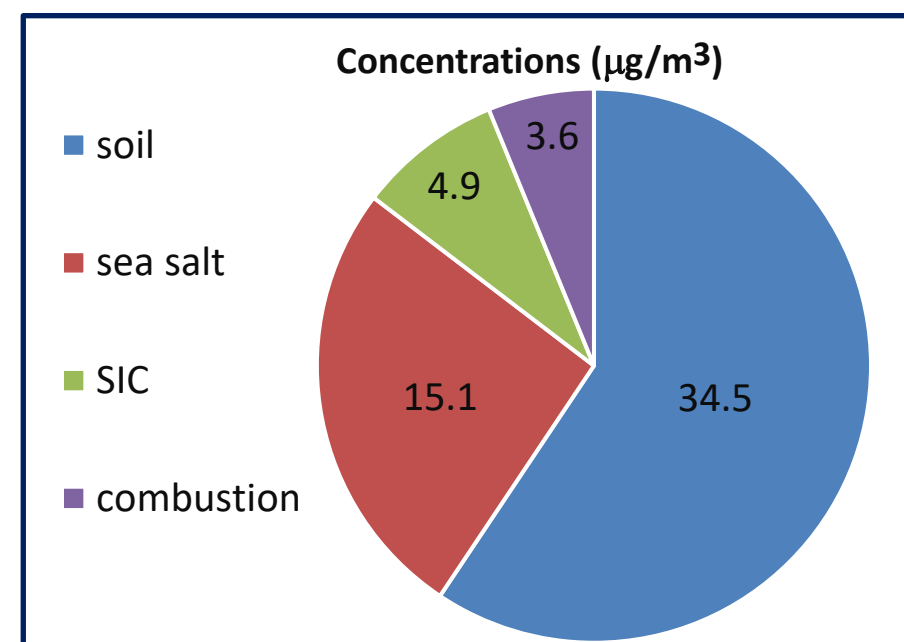


### Long term sampling campaign

(PM samplers, real time monitors of BC and particle size distributions, meteo station)



PM filters



### CHEMICAL ANALYSIS

- OC/EC
- Water-soluble ions
- Elements
- Organic constituents

### SOURCE APPORTIONMENT

- PMF
- Ionic and Mass Balance



# 3. Characterisation of emissions:

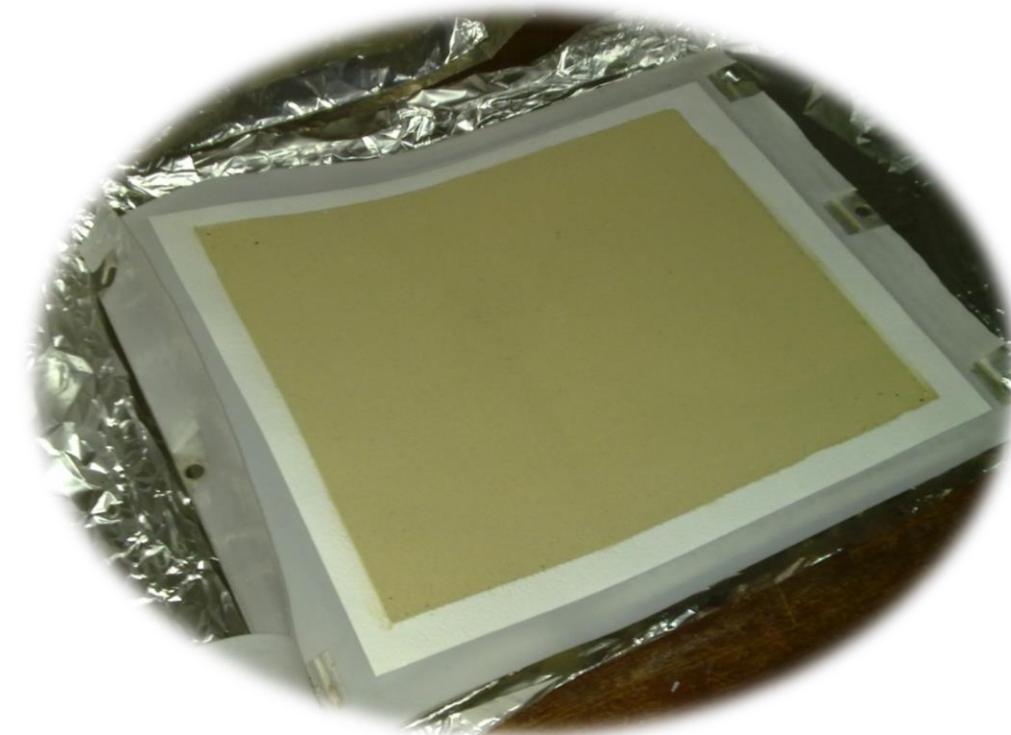
## a. Wildfires



Tedlar bags to collect gaseous samples



Tri-pod high-volume atmospheric  
particulate matter sampler



PM chemical composition



CO, CO<sub>2</sub>,  
hydrocarbons

**EMISSION  
FACTORS**



# 3. Characterisation of emissions:

## b. Residential biomass combustion



1

Traditional brick fireplace



2

Traditional cast iron wood stove



3

Eco-labelled chimney-type wood stove



4

Pellet stove



Real time composition of flue gases by FTIR



PM sampling in the dilution tunnel connected to the exhaust chimney



# 3. Characterisation of emissions:

## c. Cooking



university canteen



charcoal-grilled chicken restaurant



wood-oven roasted piglet restaurant



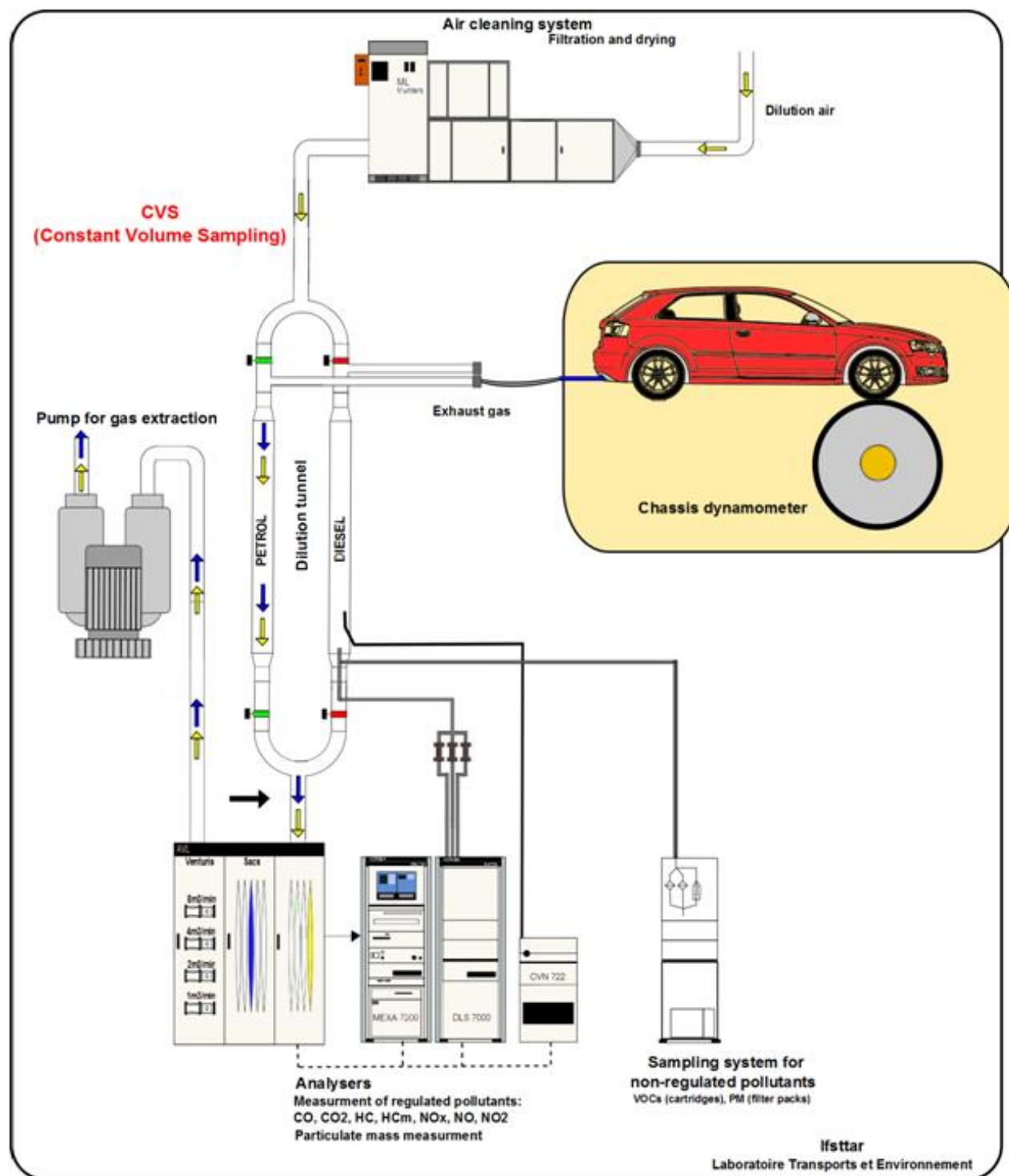
Emissions from the stacks of restaurants

Emissions in a kitchen and influence on indoor air quality





# 3. Characterisation of emissions: d. Traffic (exhaust)



Measurement of tailpipe emissions of combustion gases and particles in laboratories equipped with chassis dynamometer

- Light duty vehicles (from Euro 3 to Euro 6)
- Heavy duty vehicles
- Vehicles fuelled by gasoline, diesel, biodiesel and gas



### 3. Characterisation of emissions: d. Traffic (non-exhaust)



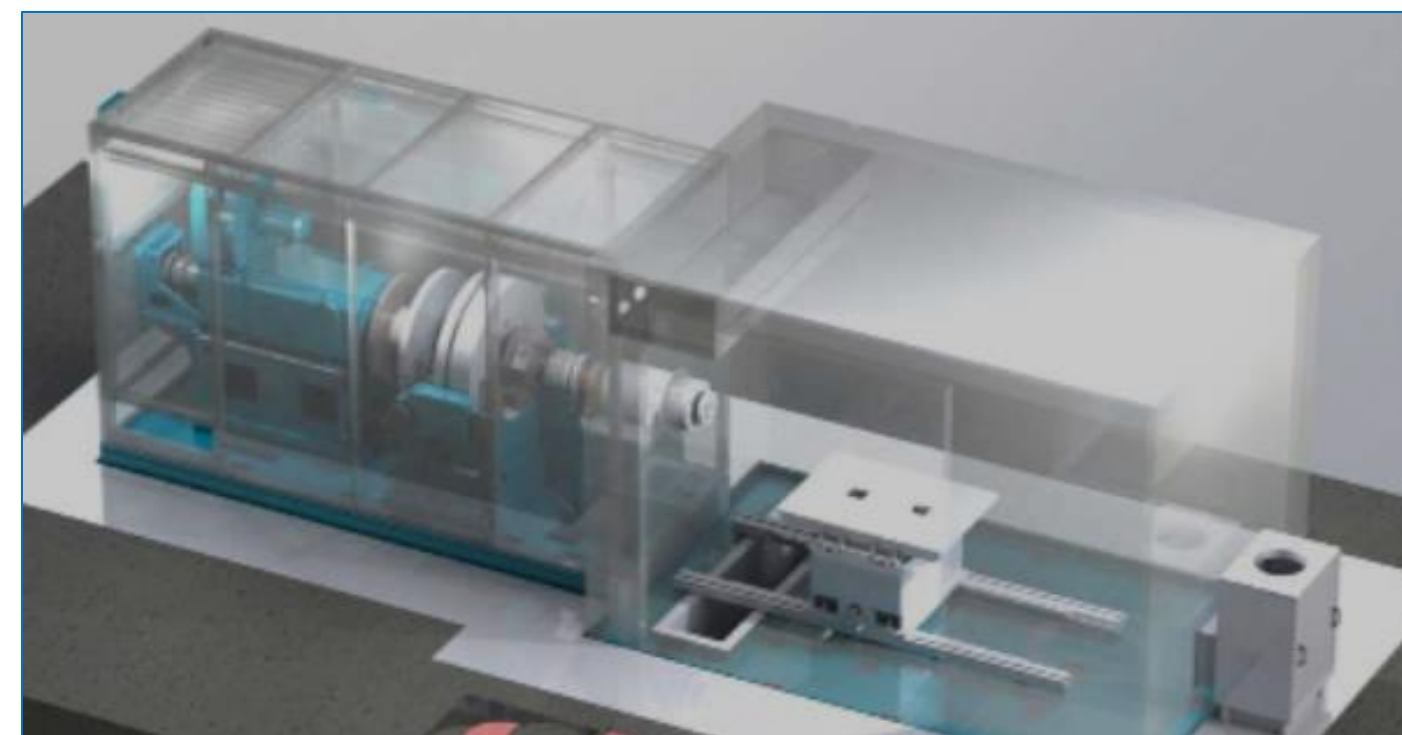
Road Simulator

**Particles from the  
interaction between  
pavements and tyres**



*In situ* resuspension chamber

**PM<sub>10</sub> from road dust  
resuspension**



Brake Testing Machine

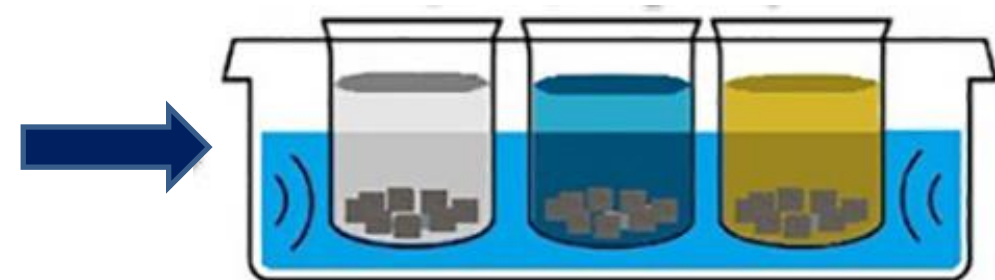
**PM<sub>10</sub> from brake wear**



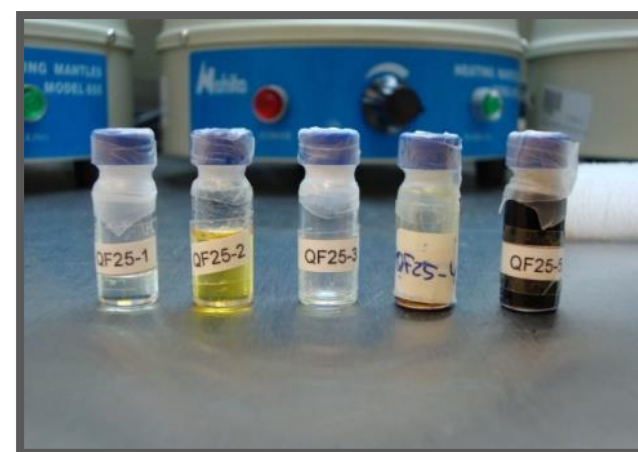
# 4. Toxicology of particulate matter



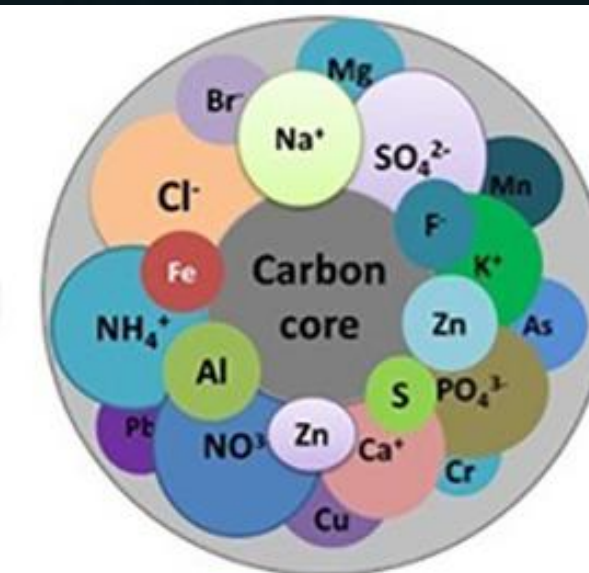
PM filter



Multi-solvente extraction



Extracts of PM-bound constituents



Chemical analysis

**ECOTOXICITY  
Screening**

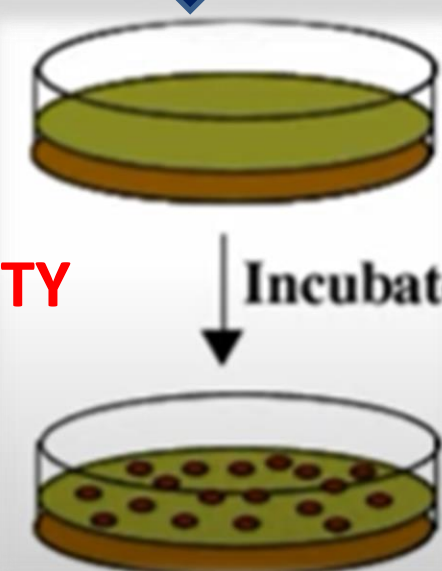


*Vibrio fischeri*



Bioluminescence

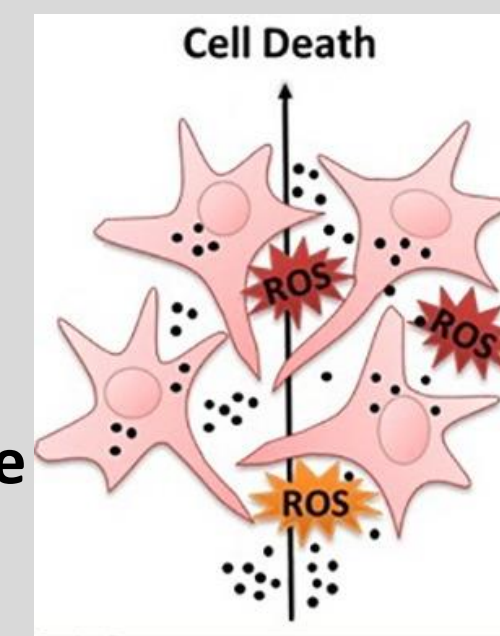
**MUTAGENICITY**



Incubate

*Salmonella typhimurium* reverse  
mutation assay (Ames test)

**CYTOTOXICITY  
GENOTOXICITY**  
(membrane  
integrity, cell  
metabolic  
activity, oxidative  
stress, cell cycle  
dynamics)



Lung epithelial cells



## 5. Emission/deposition fluxes of GHG

City centre of Oporto, since 2014



Maritime pine forest  
(Mata Nacional das Dunas de  
Quiaios) burnt during the  
wildfires of October 2017, in  
operation since summer 2021



Latent (LE) and sensible (H) heat fluxes

Water vapor fluxes

CO<sub>2</sub> & CH<sub>4</sub> fluxes

**Eddy covariance towers**



# Funding projects



Source apportionment of URBan Emissions of primary particulate matter, PTDC/AAC-AMB/117956/2010 (URBE)

Contribution of biomass combustion to air pollutant emissions, PTDC/AMB/65706/2006 (BIOEMI)

Atmospheric aerosol in Cape Verde region: seasonal evaluation of composition, sources and transport, PTDC/AAC-CLI/100331/2008 (CV-Dust)

