

# ANALYSES OF HUMAN EXPOSURE TO URBAN AIR QUALITY IN A CHILDREN POPULATION

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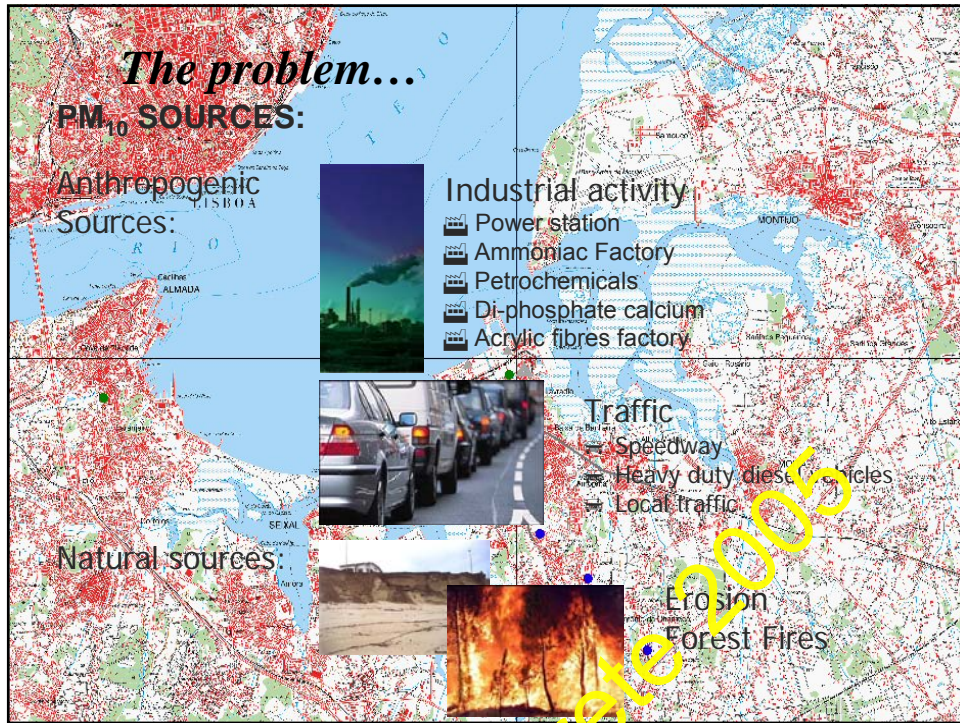
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## Objectives

- Correlate indoor and outdoor Particle Matter with less than 10µm diameter (PM<sub>10</sub>) concentration using modelling and measurements
- Study human exposure to urban air pollution in a children population





Setúbal  
District



ANALYSES OF HUMAN EXPOSURE TO URBAN AIR QUALITY IN A CHILDREN POPULATION

**Methods**

- **Measurements** - Outdoor and indoor PM<sub>10</sub> concentration
- **Human exposure** – Data of paediatric population with respiratory problems observed in hospital urgencies.  
S-plus 6 for windows: Statistical Software  Explore.exe
- **Simulation** - ADMS-Urban: Atmospheric Dispersion Modelling System (CERC) 

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## Methods - Measurements

- PM<sub>10</sub> hourly measured using a Beta Gauge Dust Monitor



Outdoor PM<sub>10</sub> concentration measured by CCDR-LVT



Indoor PM<sub>10</sub> concentration measured by ESTSetúbal

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## Methods - Measurements

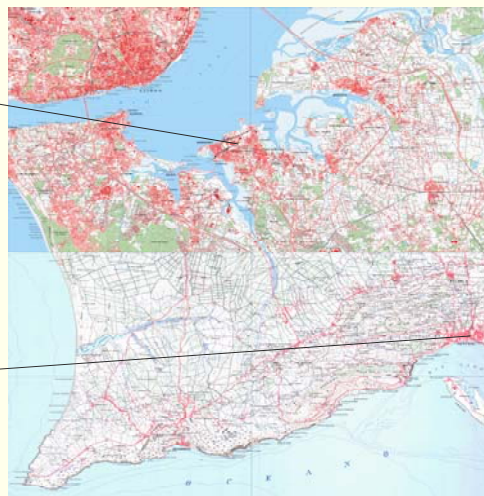
- Two schools in Setúbal district, Portugal, for a week period each



1<sup>st</sup>. Classroom



2<sup>nd</sup>. Classroom



## Methods - Measurements

- Activities developed in the classrooms

- 1<sup>st</sup>. Classroom

Activity	Date	Period
no. open windows	2 07/07/2005	4:10 p.m.-6:00p.m.
	2 08/07/2005	1:09 p.m.-6:45p.m.
	4 11/07/2005	11:30 a.m.-3:00 p.m.
Administrative work	07/07/2005	4:10 p.m.-6:00 p.m.
	08/07/2005	1:09 p.m.-1:30 p.m. and 3:45 p.m.-6:45 p.m.
	11/07/2005	11:30 a.m.-3:00 p.m.

- 2<sup>nd</sup>. Classroom - Deactivated

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## Methods - Measurements

### Classrooms characterization

	1 <sup>st</sup> . Classroom	2 <sup>nd</sup> . Classroom
Vol. (m <sup>3</sup> )	164	258
no. windows	7	6
Windows area (m <sup>2</sup> )	2	2.5
Windows direction	NW/NE	W
Windows protections	Blind	Blind
Floor type	Wood	Mosaic
Furniture	Wood	Wood

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## Methods - Human exposure

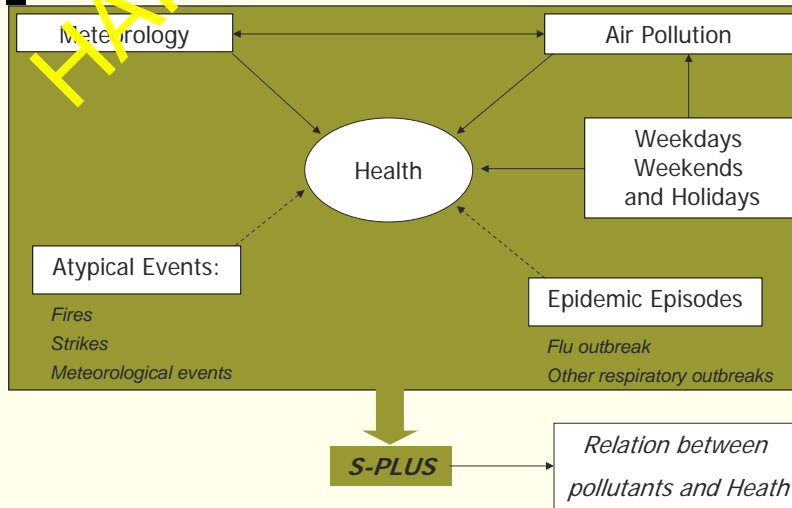
Effect of air pollution in children health



Paediatric population with respiratory problems observed in Barreiro city hospital urgencies

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## Methods - Human exposure



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## Methods - Simulation

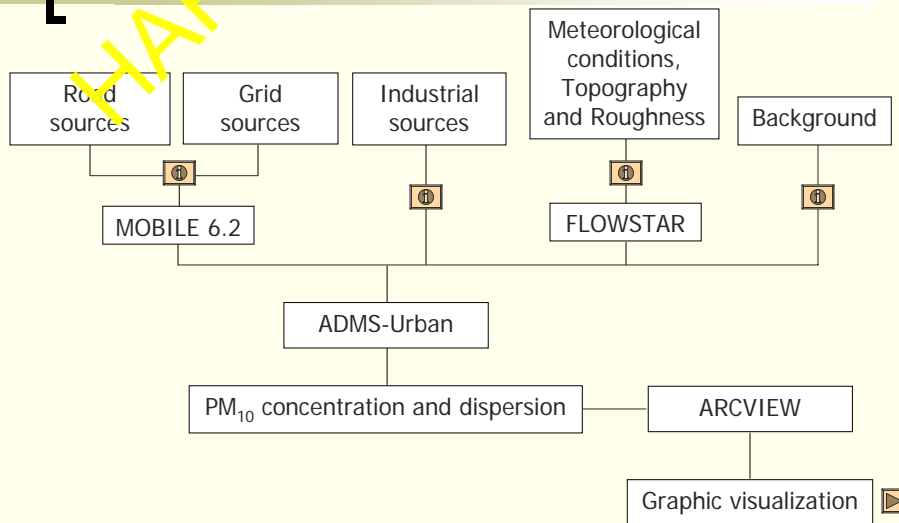
Outdoor air quality simulation



- Most affected schools
- Relation between children of most affected schools and hospital admissions

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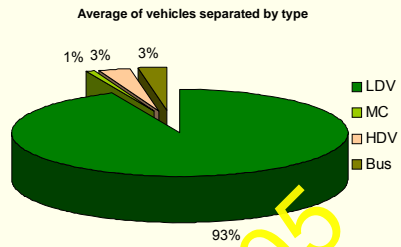
## Methods - Simulation



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## Road Traffic Characterization

- Vehicles counting
- Average speed
- Fleet characterization
  - LDV – Light duty vehicles
  - HDV – Heavy duty vehicles
  - MC – Motorcycles
  - Bus – Buses
- Street characterization
  - Road Width
  - Canyon height



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## Industrial Characterization

- Chimney characterization
  - Height
  - Diameter
- Effluent characterization
  - Velocity
  - Temperature
- Emission rate
  - Measurements made by industries

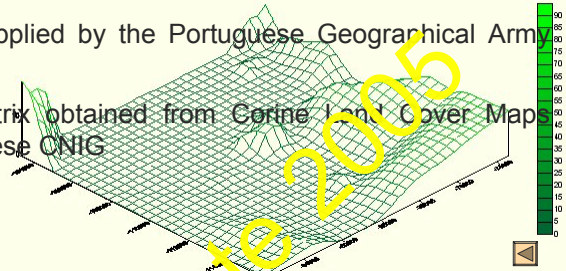


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## Meteorological and Topographic Characterization

- Meteorological data - Climatic acquisition station located in Barreiro and Setúbal (average of 30 years) - supplied by the Portuguese Meteorological Institute
- Meteorological variables - Wind speed and direction, temperature, humidity and atmospheric stability
- Topographical data supplied by the Portuguese Geographical Army Institute
- Roughness length matrix obtained from Corine Land Cover Map provide by the Portuguese CNIG



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## Background

- Measurements from air quality monitoring background stations made by CCDR-LVT

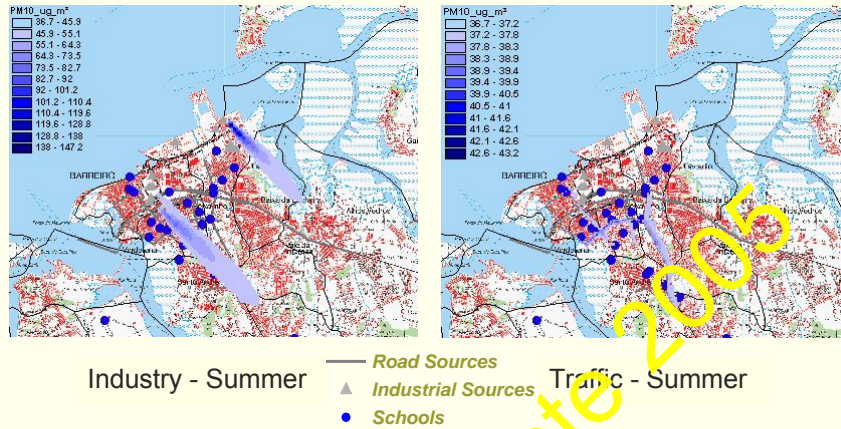


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## Results - Simulation

- Concentration and distribution of PM<sub>10</sub>



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## Results - Statistical Results

Measurements data separation:

- Weekend - Saturday to Sunday
- Weekday - Monday to Friday
- Day - 8 a.m. to 8 p.m.
- Night - 8 p.m. to 8 a.m.
- Activity Days (in the 1<sup>st</sup> classroom)

Calculated parameters

- PM<sub>10</sub> concentration average
- PM<sub>10</sub> concentration median
- Average ratio between indoor/outdoor (I/O)
- Correlation between indoor and outdoor measurements

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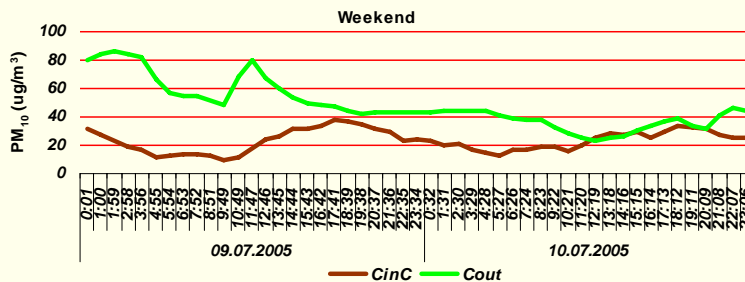
## Results - Statistical Results

	Average (PM <sub>10</sub> Conc.)		Median (PM <sub>10</sub> Conc.)		I/O ratio average	Correlation
	Indoor	Outdoor	Indoor	Outdoor		
<b>1<sup>st</sup> Classroom</b>						
Weekend	23.26	48.12	24.42	44.12	0.55	-0.20
Weekday	22.03	47.24	17.76	46.20	0.52	0.57
Day	23.28	47.47	18.87	47.18	0.58	0.45
Night	21.47	47.52	18.87	43.29	0.49	0.49
Activity Days	25.11	51.09	19.98	51.06	0.69	0.34
<b>2<sup>nd</sup> Classroom</b>						
Weekend	14.57	18.93	14.43	19.70	0.74	0.91
Weekday	21.94	29.24	17.21	22.06	0.80	0.63
Day	21.05	29.20	17.21	22.06	0.78	0.91
Night	19.67	27.15	14.43	19.33	0.77	0.95

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## Results - Statistical Results

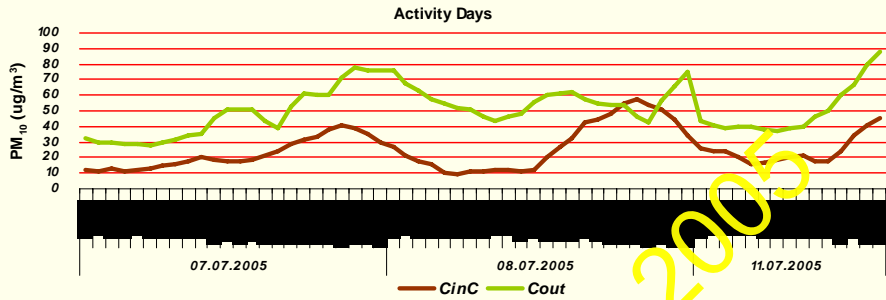
- Outdoor and Indoor measurements concentration on weekend, 1<sup>st</sup> classroom



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## Results - Statistical Results

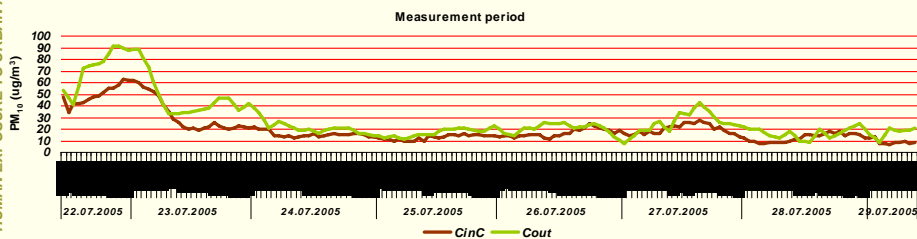
- Outdoor and Indoor measurements concentration on activity days, 1<sup>st</sup> classroom



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## Results - Statistical Results

- Outdoor and Indoor measurements concentration on all measurement period, 2<sup>nd</sup> classroom



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## Conclusions

- Indoor activities have a great influence in indoor PM generation
- Positive correlation between indoor and outdoor PM concentrations, whatever the building permeability
- 1<sup>st</sup> Classroom activity days increase I/O PM<sub>10</sub> ratio exceeding the unit => bigger influence of indoor PM sources
- In no activity days I/O is greater in 2<sup>nd</sup> Classroom => building have a greater permeability => bigger risk to this children
- 1<sup>st</sup> school is near the industrial zone => greater PM<sub>10</sub> outdoor concentration. Providing the classrooms with air conditioner avoid PM<sub>10</sub> outdoor penetration by open windows

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## Conclusions

- Relation between children and PM<sub>10</sub> was inconclusive. It is important to continue this study:
  - by following a children sample with respiratory problems, not only the urgency cases
  - continue the evaluation of indoor and outdoor PM<sub>10</sub> relation
  - study children surrounding environment
- Simulation of outdoor PM<sub>10</sub> concentration and distribution is important to study the pollutants behaviour in specific meteorological conditions:
  - Know most affected schools and study this children population.
  - Alert the authorities when PM concentrations prediction exceed or are near the legal limits.

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