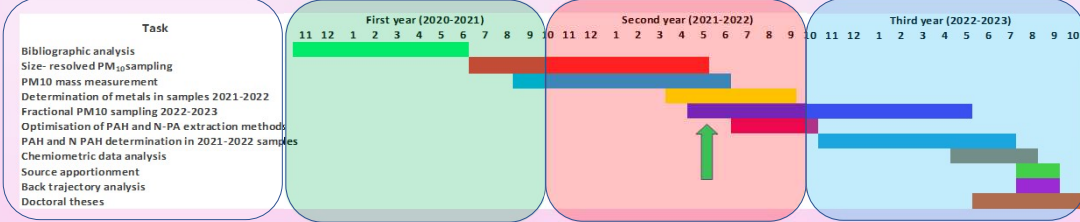




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PhD Supervisor Prof.ssa Silvia Illuminati,

**INTRODUCTION**

The main goal of the present PhD project is to sample, chemically characterize and study the spatial-temporal evolution of organic and inorganic pollutants in the atmospheric particulate matter over the city of Ancona, a highly polluted area of the Marche Region. The harbor of Ancona has recently become a crucial step in the MSC cruises along the Adriatic Sea, adding an additional source of atmospheric pollution, especially concentrated during summer.



**EXPERIMENTAL SECTION**

**1. Field sampling**

Ancona - Campus of the Università Politecnica delle Marche  
 ➢ First direct measurements of size-segregated aerosol mass fractions  
 ➢ From July, 2021 to March, 2022  
 ➢ The sampler is equipped with a five-stage high-volume cascade impactor coupled to a 10 μm pre-separator for the effective collection of six PM<sub>10</sub> fractions.  
 ➢ Flow rate at 1.13 m<sup>3</sup> min<sup>-1</sup>  
 ➢ 3-day sampling strategy, samples were collected twice at month during summer and one time at month during the remaining part of the year.



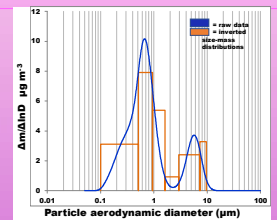
**2. Aerosol mass weighing**

- Differential weighing procedure previously set-up<sup>1</sup>
- Weighing conditions: T = 25 ± 2°C; RH = 40 ± 2%
- Electronic microbalance (Radwag XA.3Y.F) with weighing chamber and pan specifically designed for filter weights



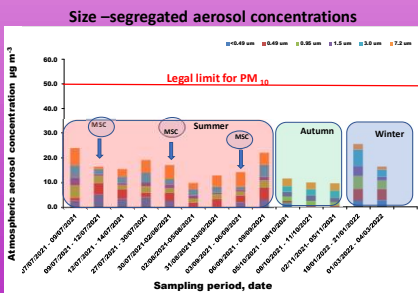
**3. Cascade-impactor data inversion**

- Inversion methodology for continuous aerosol mass size distribution<sup>2</sup>
- Results reported in the differential form Δm/ΔlnD (Δm = mass concentration for each stage; ΔlogDp = difference of logarithms of stage size boundaries)



**RESULTS AND DISCUSSION**

**Aerosol mass concentrations**



Data were referred to T and P conditions calculated as averages during the period of each individual sampling

Size-segregated aerosol reported as particle diameter ranges, means (min – max ranges):

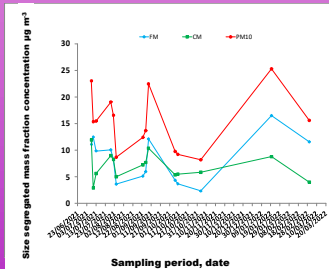
μm	μg m <sup>-3</sup>
10-7.2	3.7 ± 0.4 (1.0-6.8)
7.2-3.0	3.2 ± 0.3 (1.2-6.6)
3.0-1.5	1.6 ± 0.17 (0.5-4.1)
1.5-0.95	2.5 ± 0.3 (1.3-5.1)
0.95-0.49	2.7 ± 0.3 (0.4-4.9)
<0.49	2.3 ± 0.3 (0.2-5.1)

The average mass concentration of the total PM<sub>10</sub> given as sum of the mass concentration of each fraction is 16 ± 1.4 μg m<sup>-3</sup> (min 4.6- max 33)

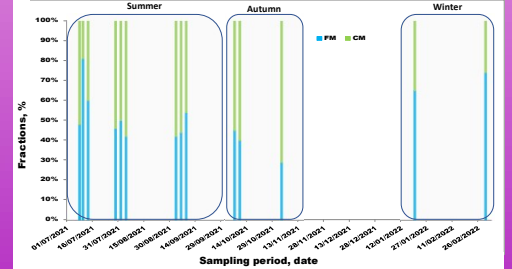
These values are in good agreement with those measured by the fixed stations belonging to the Air Quality Survey Network of the Marche Environmental Protection Agency (ARPA-MARCHE). The total PM<sub>10</sub> mass concentration is below the legal limit of 50 μg m<sup>-3</sup> established by the Italian law (Italian Dlgs n. 155, 2010) in the enactment of the Ambient Air Quality Directive 2008/50/EC of the European Union and WHO references values.

**Aerosol mass size distribution**

**Seasonal trend of different particle modes**



**Relative contribution of particle modes to total PM<sub>10</sub>**



Two modes can be recognized: 1. fine mode FM (<2.5 μm) 2. coarse mode CM (2.5-10 μm) :

The contribution of each mode is :  
 FM ~ 55 % of total PM<sub>10</sub>  
 CM ~ 40% of total PM<sub>10</sub>

The contribution in the different seasons of total PM<sub>10</sub> is:  
 Summer season: FM ~ 52 %  
 CM ~ 48%  
 Autumn season: FM ~ 38 %  
 CM ~ 62%  
 Winter season: FM ~ 70 %  
 CM ~ 30%

• FM increases during the summer week-ends, in particular during the cruise ship's stationing in the harbor of Ancona, in agreement with the data reported in the literature<sup>3</sup>.  
 • FM increases during winter season probably due to domestic heating.

**FUTURE PERSPECTIVES**

- ❖ Analysis of metals in the samples taken
- ❖ Analysis of back trajectories to determine the sources of atmospheric particulate matter
- ❖ Development of analytical extraction methods for PAHs and N-PAHs
- ❖ New PM<sub>10</sub> measurement campaigns for the subsequent determination of PAHs and n-PAHs

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1. S. Illuminati, S. Bau, A. Annibaldi, C. Mantini, G. Libani, C. Truzzi, G. Scarponi. Atmos. Environ., 125 (2016) 212-221.
2. Bau, S., Witschger, O. J. Phys. Conf. Ser. 429 (2013) 012002/1-012002/10.
3. M. Viana, P. Hamminght, A. Colette, X. Querol, B. Degraeuwe, I. De Vlieger, J. Van Aardenna. Atmos. Environ. 90 (2014) 96-105