

THE DESIGN OF AN AIR POLLUTION MONITORING NETWORK: ROMA URBAN AREA- ITALY

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ABSTRACT

The study presented in this paper was carried out by the Local Administrative Authorities in order to re-design the air quality monitoring network of the city of Rome (Italy) according to the new European Directive. A territorial analysis of urban area, pollutant and population distribution at macro and micro scale was performed using a statistical approach. Because traffic emissions can be considered the major sources of pollutants in Rome, the methodology proposed took into account not only the population distribution but also its daily fluxes.

Finally, merging the critical state index map and the classified road map, a new air pollution monitoring network was designed.

Key.Words: Urban Air Quality, Air Pollution, Monitoring Network.

1. INTRODUCTION

In the last years, problems connected with air quality in great urban areas and with the stresses that the atmospheric pollution cause on the human health have urged the European Community to create a framework to establish criteria for air quality data collection and analytical techniques with particular reference to the location and the minimum number of sampling sites. In particular it has been proposed that air quality monitoring focused on the protection of human health, must be performed in areas where the exposition to the high levels of pollutions is maximum, for a significant period of time and that the areas chosen for monitoring should be representative of other similar areas.

Two different type of station are defined:

Urban/suburban background stations: used to monitor the ‘average’ air pollution levels (urban background concentration) resulting from transport of air pollutants from outside the urban area and from emissions in the city itself. The stations are, however, not directly influenced by dominating emission sources like traffic or industry .

Traffic stations: located where the level of pollutants is particularly influenced by emissions coming from near roads. This kind of stations are located in areas characterized by an high gradient of concentration.

In Italy the application of EuroAirNet criteria has been entrusted to local administrations; the Latium Region, in which is located the city of Rome, has been

charged therefore, to assess whether the existing monitoring network follows the new criteria either for the number of sites for the different pollutants or for their locations.

2. MAIN TEXT

The Rome Metropolitan Area is located on the west coast of the central Italy, in the Latium Region, along the Tiber River Valley, not too far from the Apennines Range. Rome Municipality, one of the biggest in Europe, covers about 1400Km²; most of its territory is covered by vegetated and agricultural lands and only the central area is prevalently built as evident in figure 1 where land use map of the Roman municipality territory is shown.

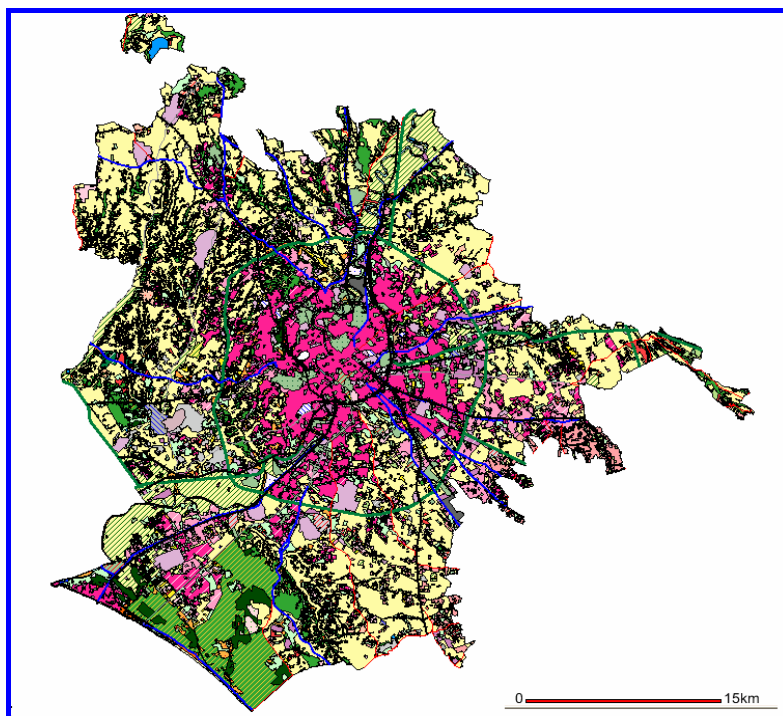


Figure 1. Land Use map of the roman territory. In magenta urban areas, in yellow crops, in different green tones vegetation cover are shown. The roads network is in blue but the green circle is the GRA.

The Great Ring Road (GRA, Grande Raccordo Anulare), with about 20 km of diameter, marks the boundary of the densely populated urban area; moreover in this central area, it is possible to recognize, along the main historic roman roads and XIX century villas, areas dedicated to natural parks (i.d. Appia Antica sub-urban park). Administrative, political and services are the main Rome activities, including transport and all assets related to tourism; these activities are particularly concentrated in the central area within the GRA where 80% of the populations (about 2 750 000 inhabitants) lives (Table1).

In the territory of Rome Municipality, traffic emissions represent the main pollutant source: more then 2.000.000 vehicles per day travel along the city roads. Any major

industrial or thermoelectric plant are located in the surrounding areas and the amount of pollutants produced by domestic heating is in any case negligible.

According to the European directive EuroAirNet, the Italian legislation (*DM 60/2002*) points out that both pollutant concentrations and *exposure* of people to the air pollution have to be considered when a monitoring network will be designed.

Table 1. Census data

AREA	km ²	inhabitans	Working population
outside GRA	1055	604564	100277
inside GRA	327	2145747	853226
<i>ROME</i>	<i>1382</i>	<i>2750311</i>	<i>953503</i>
% inside GRA	23,67	78,02	89,48

In this work, consequently, the geographic distribution of pollutants in the city of Rome and the population density data were both used to identify the areas where these values are both above the average; these, of course, will be the most suitable areas for the location of the monitoring stations.

In a previous study realized by the local regional administration (DGR n. 767 del 1 agosto 2003), in order to divide the territory in air quality homogeneous sub-areas, a multi-task decision model was applied. Considering the high values of pollutants measured, their heterogeneity, the extension and the high number of inhabitants of the territory, the studied area was divided in 164 sub-areas, taking into account:

- the spatial distribution of resident populations as proxy of the amount of pollutants due to domestic heating,
- the traffic emission data,
- air quality maps computed by the regional monitoring authority
- pollutants data (Benzene, Ozone, NO₂) derived by several diffusive sampler campaigns carried out by Roman Municipality

For each sub-areas, an air quality index was computed and the entire territory was then classified to obtain an air quality index map in which the values range between 1 (lower level of air pollution - higher air quality) and 4 (higher level of air pollution – lower air quality).

The resulting map (figure 2a) has been considered as the starting point to evaluate the distribution of pollutants in the city of Rome.

Data derived by the general census of inhabitants/housing and of industrial/shopping activities held in 2001 was used to prepare population density maps (figure 2b,2c) paying particular attention in setting apart the amount of resident population (people that lives in the area) and working population (people that are in the area only during the working hours). It is important to notice that Rome territory is divided into 5808 census sections, each one with different surface but almost the same amount of inhabitants: the surface of the section range between 1200m² and 60 Km², with a mean value of 230.000 m².

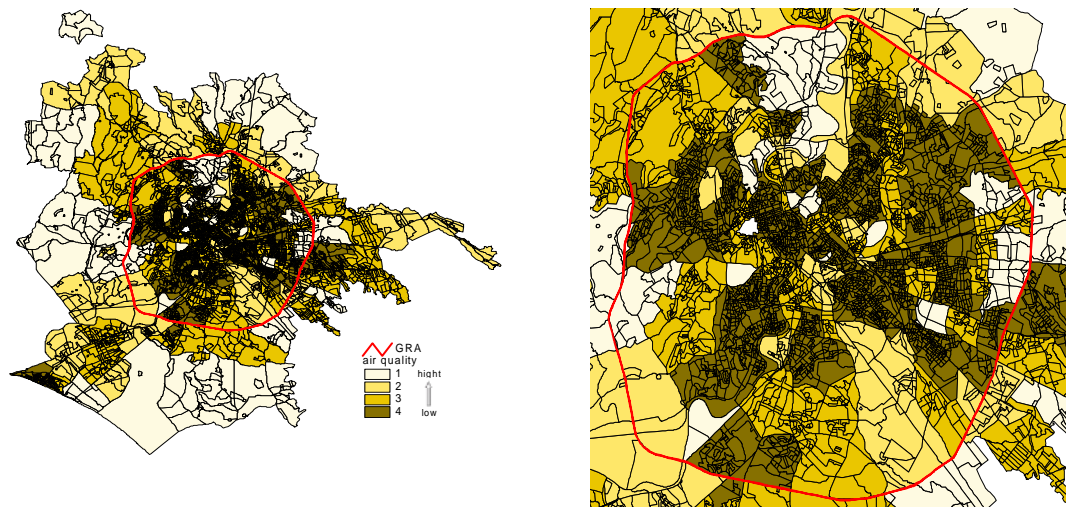


Figure 2a. Air quality map of Roman Municipality; on the right, inside GRA area

