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Analysis of the Air Pollution Sources in the city of Rome (Italy)

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Abstract

Pollution depends on many natural and human factors. The variation of pollutant and weather changes modify the concentration of pollutant in time and space. In fact, this is not only a local problem, but a regional and even global influence is highlighted. People who moved from the countryside to the cities made the air condition worse, because of the factories activities and the domestic heating. These kinds of pollutants, together with the ones related to the urban traffic, are the base of the air toxicity, which can lead to a lot of health problems. Apart from people, even monuments and works of art can be damaged by pollution, especially in the city centres. Exposure to pollutants is usually higher in cities than in the countryside. The more common pollutants produced at high density urban areas are carbon monoxide (CO), nitrogen oxides (NO_x), sulfur oxides (SO_x), ozone (O_3), particulate matter (PM) and benzene (C_6H_6). The aim of this work is to study the air pollutant level in the city of Rome in order to analyse the emissions from different sources. Furthermore, the pollutant exceeds of the limit of the Directive 2008/50/EC, the main legislation about ambient air quality, was analysed for the period taken into account.

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Keywords: air quality, pollutant emissions, statistic analysis, domestic heating, urban traffic, human exposure, weather data.

1. Introduction

In the last few years many epidemiological studies have shown associations between air pollutant concentrations and human health [1–5]. Apart from people, even monuments and artworks can be damaged by pollution, especially in city centres. Furthermore, urbanization modified microclimate conditions of the cities, and, together with urban traffic and domestic heating [6, 7], led to a discomfort of living condition. People who moved from the countryside to the cities made the air condition worse, because of the factories activities and the domestic heating. These kinds of pollutants, together with the ones related to the urban traffic, are the base of the air toxicity, which can lead to a lot of health problems [8–12]. The urban development of cities modified temperature, wind direction and humidity; these elements, together with urban traffic and a wrong kind of domestic heating, led to a discomfort of living condition in the cities [13–21]. Besides the increase of pollutions, urbanization has led to an increase of the urban heat island

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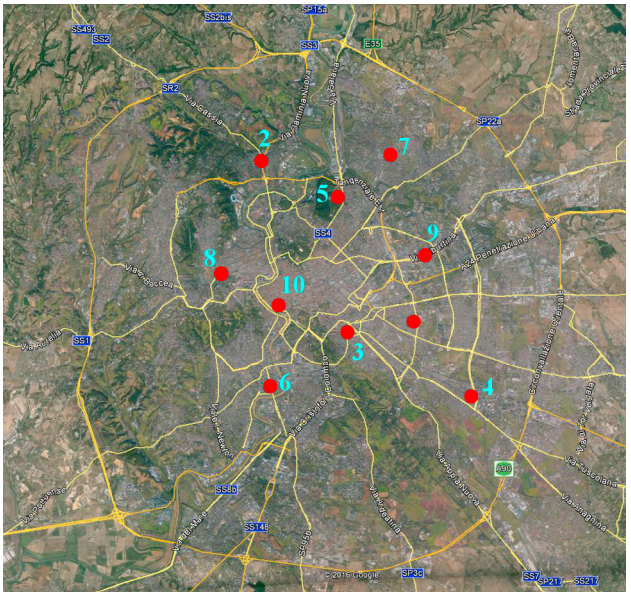

Fig. 1. Google Earth map of Rome. Red circles are the monitoring stations taken into account

intensity (spatially-averaged surface or air-temperature difference between an urban and surrounding rural area(s) [22]). Several studies are focused on the reduction of urban heat island effect with different mitigation techniques [23–26]. Moreover, tall buildings reduce wind circulation, so even the dispersion of air masses is limited [27–32]. To check these conditions is important to maintain an acceptable level of living conditions, especially in some areas, and it is a way to set a long term programme of improvement. First of all, urban traffic should be limited and domestic heating should be improved by the changing the old boilers with new ones which can guarantee the right amount of energy with more efficiency. The aim of this work is to study the air pollutant level in the city of Rome in order to analyse the emissions from different sources.

2. Materials and Methods

2.1. Characteristics of the Study Area

Rome is the capital of Italy and one of the most overcrowded cities of Europe (3 million people for 12850 km^2). Considering the extra urban areas, people are more than four million. It is an historical city that traces its origin in 753 a.C. and it was the capital of the biggest empire ever. That's why it is known as the eternal city and its cultural heritage finds no equals. Thanks to its position, Rome shows a Mediterranean climate: temperate winter and hot summer, with a temperatures that goes from 0 to 36 degrees. The greatest problem of this city is the lack of an adequate net of means of transport, so people use cars [33]. Apart from urban traffic, there are a lot of other pollutant activities such as domestic heatings.

2.2. Monitoring Station Network

ARPA Lazio is the agency that monitors the air condition in Rome [34]. The Rome monitoring network consists of different monitoring stations of $[CO]$, $[SO_2]$, $[NO_x]$, $[NO]$, $[NO_2]$, $[C_6H_6]$, $[PM_{10}]$, $[PM_{2.5}]$ and $[O_3]$ that are shown in Figure 1. They collect data hour by hour in a place with a great concentration of pollution.