AIR QUALITY MONITORING NETWORK DESIGN TO CONTROL PM_{10} IN BUENOS AIRES CITY

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***Abstract*— An air-quality monitoring network properly designed is a key component of any air quality control programme. This paper presents an objective procedure to determine the minimum number of monitoring sites needed to detect the occurrence of background air pollutant concentrations greater than a reference concentration level (C_L) in an urban area. We propose an air quality monitoring network design based on the analysis of the results of atmospheric dispersion models, in order to identify the grid cells (in which the city is divided) where the air pollutant concentration exceeds C_L. At present, Buenos Aires city has not an air quality monitoring network. This paper also describes the application of the proposed methodology to design a monitoring network to control PM_{10} levels in Buenos Aires. Results show that four monitoring stations are required to detect the occurrence of PM_{10} 24h-concentrations greater than C_L=0.150 mg m^{-3}.**

***Keywords*— Urban Air Quality, Air Quality Management, PM_{10} Monitoring Network.**

I. INTRODUCTION

Cities are by nature concentrations of humans, materials and activities. They therefore exhibit both the highest levels of pollution and the largest targets of impact. Air pollution is, however enacted on all geographical and temporal scales, ranging from strictly "here and now" problems related to human health and material damage, over regional phenomena like acidification and forest die back with a time horizon of decades, to global phenomena, which over the next centuries can change the conditions for man and nature over entire globe. In this respect the cities act as sources.

Urban areas with high population densities are often exposed to poor air quality. While in the past the major source of poor air quality was industrial activity, because of the rapid increase in mobility the major current urban air pollutants are particulate matter, nitrogen oxides and ozone. The best example of this can be found in the poor air quality of Los Angeles area (USA), Mexico City, Santiago (Chile) and Sao Paulo (Brazil). Motorized traffic is responsible for a considerable part of nitrogen oxides emissions and emissions of ozone precursors.

The monitoring of pollution levels in the atmosphere is of fundamental importance because it enables us to measure the extent to which pollution is actually occurring, it provides us a guide as to how effective our controls are proving and it indicates where greater effort is needed. The design of an air pollution monitoring network depends on the purpose for which the information concerning pollution levels is to be used, the degree of accuracy required and the economics of establishing and operating a network. In previous studies, various statistical and optimisation models have been applied for designing representative air quality monitoring systems. Most of them have been developed for point sources (Noll *et al.*, 1977, Noll and Mitsutomi, 1983, Mazzeo and Venegas, 2000) and some of them for urban area sources (Elsom, 1978, 1979, Venegas and Mazzeo, 2003c). Among these procedures, spatial correlation (Elsom, 1979, Handscombe and Elsom, 1982), Monte-Carlo variance reduction approach (Nakamori *et al.*, 1979), population dosage product and statistical technique based on Fisher's information measures (Husain and Khan, 1983), have commonly been applied in the past. Other procedures have been presented in Shindo *et al.* (1990) and Wu and Chan (1997). Different authors have presented methodologies for designing an air pollution-monitoring network using atmospheric dispersion models (Seinfeld, 1972, Noll *et al.*, 1977, Noll and Mitsutomi, 1983, Mazzeo and Venegas, 2000, Tseng and Chang, 2001, Venegas and Mazzeo, 2003c).

Buenos Aires City and surroundings is one of the three largest megalopolises in Latin America. The population of the city state is about three million inhabitants and the population of the entire area is about fourteen million. Buenos Aires City is located on a flat terrain close to the de la Plata River. This river is a shallow large-scale coastal plain estuary that covers an approximate area of 35000 km^2 and has a width of approximately 42 km in front of the city.

At present, Buenos Aires City has no air-quality monitoring network. However, several studies on air pollution in the city and air-quality monitoring campaigns have been carried out (Bogo *et al*., 1999, 2001, 2003; Venegas and Mazzeo, 2000, 2003a; Mazzeo and Venegas, 2002, 2004, Mazzeo *et al*., 2005). Another studies of the air quality conditions in Buenos Aires include the development of the first version of an emission inventory of CO and NO_X (Mazzeo and Venegas, 2003) for the city and the application of urban atmospheric dispersion models (Venegas and Mazzeo, 2003b;