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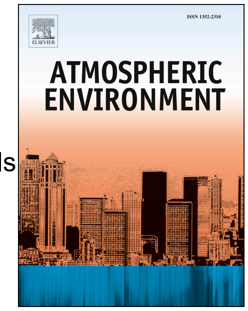

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ABSTRACT

The deterioration of urban air quality is considered worldwide one of the primary environmental issues and scientific evidence associates the exposure to ambient air pollution with serious health effects. This fact highlights the importance of generating accurate fields of air pollution for quantifying present and future health related risks. Interpolation methods for point estimations in the field of air pollution modelling enable the estimation of pollutant concentrations in unmonitored locations. The main objective of this study is to evaluate two interpolation methodologies, Artificial Neural Networks and Multiple Linear Regression, using data from a real urban air quality monitoring network located at the greater area of metropolitan Athens in Greece. The results for five regulated air pollutants (Nitrogen dioxide, Nitrogen monoxide, Ozone, Carbon monoxide and Sulphur dioxide) are compared through the use of a set of correlation and difference statistical measures and residuals distribution. Artificial neural networks are found in most cases to be significantly superior, especially where the air quality network density is limited, leading to a decreased degree of spatial correlations among the monitoring sites.

Keywords
Air quality, spatial interpolation, artificial neural networks

1. Introduction

Urban air pollution is considered a major environmental issue because it is associated with a variety of adverse effects on human health. It is considered the primary cause of mortality related to environmental conditions (Aunan and Pan, 2004; Curtis et al., 2006; Scoggins et al., 2004) among a variety of other effects (Wiedensohler et al., 2002; Tzanis et al., 2009; Ganguly and Tzanis, 2011; Varotsos et al., 2012a,b; Amanollahi et al., 2013). In order to minimize future health related risks, it is necessary to introduce a series of countermeasures based on information provided by accurate fields of air pollutant distributions. Air pollution modelling follows two different approaches. The first approach is the numerical modelling of air pollutants dispersion, which involves the simulation of dispersion and transport mechanisms using emission source data and the knowledge of the chemical transformations in the atmosphere. On the contrary, the second approach employs advanced statistical models, such as machine learning methodologies, to data from air quality monitoring networks of urban areas. The statistical approach takes advantage of the spatial and temporal correlations that are present in the air pollution concentration time series and formulate models that simulate these dependencies with a high degree of accuracy. The spatial interpolation schemes can be classified in various categories such as global or local methodologies and exact or approximate among others (Li and Heap, 2011). Air pollution point spatial estimations is an extremely important field of spatial interpolation methodologies as the available data from an existing air quality monitoring network can be used for predicting air pollutant concentrations at unmonitored locations. In this field, a commonly used linear interpolation scheme is the Multiple Linear Regression (MLR), which can generate accurate results (Vicente-Serrano et al., 2003; Rosenlund et al., 2008; Li et al., 2010; Dominick et al.,