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Article *in* Air Quality Atmosphere & Health · September 2017

DOI: 10.1007/s11869-017-0477-9

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Modeling of air pollutants using least square support vector regression, multivariate adaptive regression spline, and M5 model tree models

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Received: 8 February 2017 / Accepted: 4 April 2017

Abstract This study investigates the applicability of three different soft computing methods, least square support vector regression (LSSVR), multivariate adaptive regression splines (MARS), and M5 Model Tree (M5-Tree), in forecasting SO_2 concentration. These models were applied to monthly data obtained from Janakpuri, Nizamuddin, and Shahzadabad, located in Delhi, India. The models were compared with each other using the cross validation method with respect to root mean square error, mean absolute error, and correlation coefficient. According to the comparison, LSSVR provided better accuracy than the other models, while the MARS model was found to be the second best model in forecasting monthly SO_2 concentration. Results indicated that the applied models gave better forecasting accuracy in Janakpuri station than the other stations. The results were also compared with previous studies and satisfactory results were obtained from three methods in modeling SO_2 concentrations.

Keywords Soft computing techniques · Regression methods · Prediction modeling · Environmental management

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Introduction

Soft computing consists of different techniques, which are helpful to solve uncertain and complex problems (Corchado et al. 2011; Corchado and Herrero 2011; Vaidya et al. 2012, Kisi and Parmar 2016). It is used to investigate, simulate, and analyze complex issues and phenomenon in an attempt to solve real-world problems. Soft computing is useful where the precise scientific tools are incapable of giving analytic, low cost, and complete solution. The problem of air pollution is one of the most important problems among all, and it had come into play since the beginning. Air pollution affects both the developing and the developed countries alike. Air pollutants consist of gaseous pollutants (SO_2, NO_2, CO, etc.), odors, and suspended particulate matter (SPM) such as fumes, dust, smoke, and mist. The high concentration of air pollutants in and near the urban region causes severe pollution to the surroundings. Sulfur dioxide is a pungent, toxic gas that is in the atmosphere. Moreover, it harms the society, as it causes acid rain which affects the environment (Rizwan et al. 2013). Sulfur dioxide reacts in the atmosphere to form aerosol particles, which can create outbreaks of haze and other climate problems. The main sources of SO_2 are volcanic and anthropogenic emissions from burning sulfur-contaminated fossil fuels and the refinement of sulfide ores (Seinfeld and Pandis 2006). According to the new analysis of data from NASA's Aura satellite, the emissions of sulfur dioxide from power plants in India increased by more than 60% between 2005

Published online: 13 April 2017