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Determination of suitable PM10 predictors in an urban area using a new feature selection technique

H. Taheri Shahraiyni (1), S. Sodoudi (2), A. Kerschbaumer (3), and U. Cubasch (2)

(1) Institut für Meteorologie, Freie Universität Berlin, Berlin, Germany (hamid.taheri@met.fu-berlin.de) & Remote Sensing Research Center, Sharif University of Technology, Tehran, Iran , (2) Institut für Meteorologie, Freie Universität Berlin, Berlin, Germany, (3) Senate Department for Urban Development and the Environment, Berlin, Germany

Particulate matter with a diameter of less than 10 μm (PM10) significantly affects aspects of atmospheric chemistry and air quality, such as dry and wet deposition, visibility, solar radiation, and cloud formation. PM10 also has a direct effect on health via inhalation. Some studies have reported the effects of particulate matter on infant birth weight. It was found that an elevated PM10 concentration in a day can increase mortality rates the following day. In some studies, a significant relationship between health effects (mortality and morbidity) and elevated concentration of particulate matter was found. Moreover, it has been demonstrated by a number of epidemiological studies that low concentrations of particulate matter can also have a large effect on human health.
PM10 prediction in urban areas is employed for urban planning and design, as well as transportation networks, industrial sites and residential areas management, in order to minimize unacceptable risks to public health. In addition, it is very useful for exposure assessment studies. Statistical modelling techniques is one of the major PM10 prediction techniques and it has widely been employed for air Pollution prediction in urban areas. Statistical modelling techniques require input variables (predictors). Applying a suitable feature selection and collinearity reduction technique in the modelling procedure can remove the irrelevant, redundant and collinear predictors and consequently, may significantly improve the results of PM10 prediction in urban areas.
PM10 predictors that have often been employed in PM10 prediction studies are: meteorological parameters, land use parameters, NDVI (Normalized Difference Vegetation Index), vehicular traffic, morphological parameters, and temporal parameters. These predictors were prepared for Berlin with PM10 data (Output data) measured at PM10 monitoring network in Berlin. The spatial predictors were generated in different buffer radii and finally, more than 150 predictors were prepared. Then a collinearity reduction technique (Breakdown of correlated variables) was employed for reduction of collinearity by removing the collinear predictors. The number of remaining predictors was about 40. Next, a new Feature selection techniques, called TSCK (Taheri-Sodoudi-Cubasch-Kerschbaumer), was used for the selection of appropriate predictors among the remaining predictors. The results showed that the eight predictors (five land use parameters, two morphological parameters and one traffic parameter) can be considered as the suitable PM10 predictors for Berlin, which are water bodies (buffer radii 500m), transport areas (buffer radii 50, 2000m), open areas (buffer radii 1000m), forest areas (buffer radii 2000m), plane area density (buffer radii 50 m), standard deviation of building height (buffer radii 50m) and mean annual traffic volume (buffer radii 100m).