Editorial

Forecasting Urban Air Quality

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Air pollution has significant impacts on both the environment and human health. Therefore, urban areas have received ever growing attention, because they not only have the highest concentrations of air pollutants, but they also have the highest human population. In modern societies, urban air quality (UAQ) is routinely evaluated and local authorities provide regular reports to the public about current UAQ levels. Both local and international authorities also recommended that some air pollutant concentrations remain below a certain level, with the aim of reducing emissions and improving the air quality, both in urban areas and on a more regional scale. In some countries, protocols aimed at reducing emissions have come in force as a result of international agreements.

While the routine assessment of UAQ is essential for analysing what has happened in the past, forecasting allows for the prediction of future trends and enables local authorities to plan new strategies aimed at reducing the risk of exposure to high levels of air pollution. For example, the EU directive (2008/50/EC) declared that Member States shall forecast air quality and inform the public if any alert thresholds are likely to be exceeded. However, whilst the forecasting of UAQ and its impact on the environment and human health is of great interest to both policy makers and the public, it is also extremely challenging. Forecasting UAQ requires long-term monitoring of the temporal-spatial variation of air pollutants, as well as data on weather patterns, anthropogenic, and biogenic emissions, and the local- and long-range transport of air pollution.

Three papers in this special issue present work on the development of statistical forecasting models that are superior in terms of their high productivity, but lacking in terms of the physical process. One paper illustrates how, in addition to vehicular traffic, meteorology also plays an important role in UAQ, and it can be used as one of the key predictors in air-quality forecasting models. The approach was based on a generalized additive model and it was applied for nitrogen dioxide (NO_2) and particulate matter (PM_{10}) in Turin-Italy during December 2003–April 2005. Another paper presents work in relation to the development of two empirical models: a Bayesian approach to forecast the next day ground-level ozone hourly concentrations and a state-space model approach. The predictions of these models were evaluated against many stations where the first approach was superior to the second. The third paper presents a forecast of daily maximum surface ozone concentration in the Athens area, based on multiple linear regression models. This paper also emphasized that basic meteorological parameters are of great importance in order to forecast ozone concentration levels. In addition, One paper presents data from an air quality management system installed at the Department of Labour Inspection in Cyprus. This system was applied for the measurement of NO_2, O_3, CO, Benzene, PM_{10}, and $PM_{2.5}$.
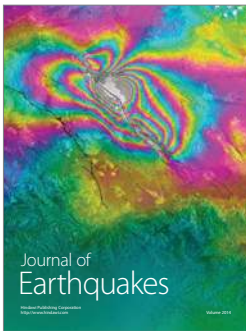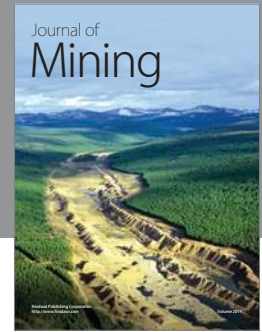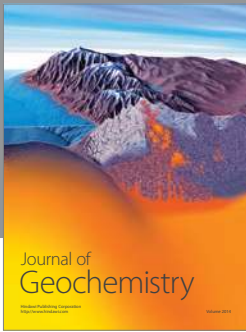
In principle, the statistical models presented in several papers, and the air quality management system presented in a paper, can be extended to other air quality parameters, with the aim of developing an integrated system to forecast UAQ. In general, statistical models are able to make highly accurate

short-term predictions, however they are unable to account for the many chemical and physical processes that impact on UAQ in the long-term.

The Community Multiscale Air Quality (CMAQ) modeling system and the CB05 mechanism were utilized in Paper IV to investigate the impact of nitrous acid (HONO) chemistry on regional ozone and particulate matter concentrations in the Pearl River Delta region. The results of the model simulations were in good agreement with the observed data for NO_x, SO_2, PM_{10}, and sulfate.

In one paper, the Weather Research and Forecasting model was applied, in conjunction with chemistry packages that were modified for use in the subarctic region, to examine the effects of using low-sulfur fuel in oil-burning facilities on $PM_{2.5}$ concentrations at breathing level in an Alaska city. The simulation results suggested that introducing low-sulfur fuel would decrease the monthly mean 24 h-averaged concentrations during the winter. The results also suggested that $PM_{2.5}$ concentrations would further decrease on days with low atmospheric boundary layer heights, a low hydrometeor mixing ratio, low downward shortwave radiation, and low temperatures. Published in this issue, by the same research group and using the same modeling approach, another paper illustrates the effects of exchanging noncertified wood-burning devices with certified ones, on the 24 h-average $PM_{2.5}$ concentrations in winter. The results showed that changing out 2930 uncertified woodstoves and 90 outdoor wood boilers would reduce the 24 h average $PM_{2.5}$ concentrations by 6% and result in pollution falling below the alert threshold levels on 7 out of the 55 simulated exceedance days.

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