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Integration of biomonitoring and instrumental techniques to assess the air quality in an industrial area located in the coastal of Central Asturias, Spain

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Abstract

Throughout the world, epidemiological studies were established to examine the relationship between air pollution and mortality rates and adverse respiratory health effects. However, despite the years of discussion the correlation between adverse health effects and atmospheric pollution remains controversial, partly because these studies are frequently restricted to small and well-monitored areas. Monitoring air pollution is complex due to the large spatial and temporal variations of pollution phenomena, the high costs of recording instruments, and the low sampling density of a purely instrumental approach. Therefore, together with the traditional instrumental monitoring, bioindication techniques allow for the mapping of pollution effects over wide areas with a high sampling density. In this study, instrumental and biomonitoring techniques were integrated to support an epidemiological study that will be developed in an industrial area located in Gijon in the coastal of central Asturias, Spain. Three main objectives were proposed to (i) analyze temporal patterns of PM_{10} concentrations in order to apportion emissions sources, (ii) investigate spatial patterns of lichen conductivity to identify the impact of the studied industrial area in air quality, and (iii) establish relationships amongst lichen conductivity with some site-specific characteristics. Samples of the epiphytic lichen *Parmelia sulcata* were transplanted in a grid of 18 by 20 km with an industrial area in the center. Lichens were exposed for a 5-mo period starting in April 2010. After exposure, lichen samples were soaked in 18-MΩ water aimed at determination of water electrical conductivity and, consequently, lichen vitality and cell damage. A marked decreasing gradient of lichens conductivity relative to distance from the emitting sources was observed. Transplants from a sampling site proximal to the industrial area reached values 10-fold higher than levels far from it. This finding showed that lichens reacted physiologically in the polluted industrial area as evidenced by increased conductivity correlated to contamination level. The integration of temporal PM_{10} measurements and analysis of wind direction corroborated the importance of this industrialized region for air quality measurements and identified the relevance of traffic for the urban area.