

Using GIS to Analyze Spatiotemporal Patterns of Industrial Air Pollution Sources and Distributions

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This study developed new methods for using a Geographic Information System (GIS) to map industrial air pollution concentrations, and to analyze temporal patterns in pollutant sources and distributions. While these methods could be applied in a wide variety of cities globally with air quality issues, this presentation will highlight applications to a part of Portland, USA, which features rugged topography that exerts strong influences on winds and atmospheric stability, along with a neighborhood near an industrial area where residents often complain of poor air quality. This study installed a network of weather and air quality stations at varying heights within the area to measure wind speed and direction, gust speed, air temperature, humidity, precipitation, barometric pressure, and air quality. Pollution measurements followed standards from the American Society of the International Association for Testing and Materials (ASTM). Through spatial interpolation and various geostatistical techniques, this study then analyzed spatial patterns in winds and air pollution for the area, at a variety of temporal scales from annual, to seasonal, daily, and sub-hourly. Results show when and where the air pollution occurs most frequently, and in combination with atmospheric data gathered by this study, plus regulatory documents pertinent to the individual industries in the area, strongly suggest which sources are producing the most pollution. Results also show potential solutions to this problem, either by informing regulatory decisions to reduce the emission of pollutants at their sources, or by changes to the schedules of emissions-producing activities by these polluters so that emissions only occur at times when atmospheric conditions would not cause them to reach high concentrations in the nearby neighborhood. Accuracy assessment of the methods developed by this study using known emissions sources in the area with known schedules of emissions suggests these results are very reliable. The new methods developed by this study thus have strong potential to help improve air quality in Portland, USA, and could be applied to a wide variety of other areas globally where industrial air pollution is a problem.

Keywords: Geographic Information Systems (GIS), industrial air pollution