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GIS FOR POLLUTION MANAGEMENT

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Abstract: *This paper presents a GIS for pollution management. GIS is used at all stages of pollution management. Before pollution has occurred, avoidance and prevention management benefits from GIS. Once pollution has occurred, the planning and response can be facilitated by GIS. After the event, cleanup programs and monitoring are organized through GIS.*

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1. INTRODUCTION

The recent development of spatial data management in the field of Geographic Information System (GIS) has created the new era of environmental modeling.

The purpose of a geographic information system is to provide a spatial framework to support decisions for the intelligent use of earth's resources and to manage the man-made environment.

A better and efficient approach to monitor the ambient air quality is to customize GIS to manage environmental data.

2. AIR POLLUTION MONITORING

Air pollution is defined as any atmospheric condition in which certain substances present in such concentrations and duration that they may produce harmful effects on man and his environment [1]. Most common air pollutants are carbon monoxide, nitrogen oxide, sulfur dioxide and total suspend particular meter (TSM). This TSM includes dust, smoke, pollen and other solid particles.

The assessment of air quality is based on the air quality limits for pollutants, which are related to average annual and daily pollutant concentration. The assessment of air pollution situation is based on data stored in central databases.

Monitoring of air pollution in larger urban areas belongs to standard routines of environmental assessment. The systems are usually divided on registering of sources of air pollution, assessment of air quality on the basis of monitoring and other relevant information (smog regulation system etc.).

Large urban areas have serious problems in ensuring a healthy life environment for their citizens, the air quality being an environmental aspect negatively influenced by the multiple pollution sources. The major sources of air pollutants are the intense traffic, thermal power plants and industry (the latter's role decreased only in the last few years due to

already enforced measures for protection). The air pollution has a specific character firstly because of the emission conditions, respectively the existence of multiple sources, various heights of pollution sources, as well as a non uniform spreading of these pollution sources.

2.1 System components. A Geographic Information System for monitoring air pollution must be composed of these subsystems: main subsystem - GIS infrastructure (hardware and software); subsystem for ground air quality monitoring; subsystem for 3D spatial monitoring; subsystem for modeling and forecasting atmospheric air quality.

2.2. System description. Such a system should develop a remotely accessed stochastic database in GIS, enabling feedback on air quality long term impacts on relevant indicators for: land-use planning, health and bio-indicators (fig. 1). System must also enable functionality for long term time series analysis in GIS, over ambient air contamination levels, against registered impacts for relevant indicators.

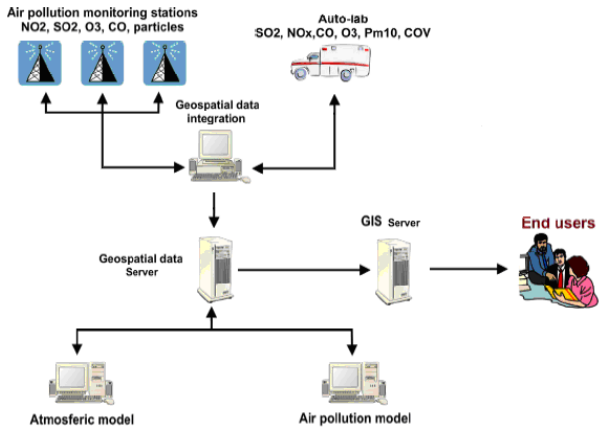

Fig. 1 GIS for monitoring air pollution

a) Main subsystem - GIS infrastructure. The role of this subsystem is to integrate data on air pollution with geospatial data. The subsystem have a geospatial database with digital maps and a GIS server that provides the end user all the data.

b) Subsystem for air quality ground monitoring. Subsystem is made up of distributed automated stations which monitor the following pollutants: NO_2, SO_2, O_3, Particles (PM10 and PM2.5), Pb, C_6H_6, CO. The monitoring system for imissions is completed by mobile measurements carried out with a specialized auto laboratory.

The sensors used for detecting air pollutants are usually produced simply by coating a sensing (metal oxide) layer on a substrate with two electrodes. Typical materials are tin oxide (SnO_2), zinc oxide (ZnO), titanium oxide (TiO_2) and tungsten oxide (WO_3). The general mechanism for a metal oxide sensor is a change in the resistance (or conductance) of the sensor when it is exposed to pollutant gas, relative to the sensor resistance in background air.

c) Subsystem for 3D spatial monitoring. The 3D monitoring system is necessary for precisely determining the actual air quality status, and for obtaining of precise initial conditions for numerical prognosis simulations, as well for calibrating models and results validation.

d) Subsystem for modeling and forecasting atmospheric air quality. Involves chemical processes, transport and dispersion of pollutants for a complex, real or forecasted state.

The subsystem aims for forecasting the 3D air pollutant "hat" evolution for various time ranges anticipation, from few hours to 2 days, knowing the emissions in the forecasted timeframe and parameters of sources

3. CONCLUSIONS

The air pollution problem originating from the various sources can be controlled by the development of air quality management system.

It is possible to improve the spatial predictions of air pollution levels by deriving an empirical regression model of the relation between pollutants and independent variables.

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