AIR QUALITY MODELLING AS A PART OF COMPLEX AIR MANAGEMENT SYSTEM IN LATVIA

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INTRODUCTION

Atmosphere air is one of the most important environmental factors influencing humans and vegetation. As a candidate country of European Union (EU), Latvia has transferred the EU air quality (AQ) legislation into the national environmental legislation. AQ management system in the country is developing in accordance to requirements laid down in relevant EU directives and introducing the modern management tools based on AQ modelling.

Irrespective of the fact that simple empirical model, namely, model "Ecolog" established in Russia in 1970-ties, have been used for regulatory AQ modelling and issuing of environmental permits for many years as well as the AQ assessment software Airviro (INDIC, Sweden) was installed in the Riga City Council in the early 1990-ties, the AQ modelling as a part of modern AQ management system is at very beginning in Latvia.

The newest tool for pollution's dispersion assessment and management EnviMan produced by OPSIS AB Company in Sweden was obtained in the Latvian Hydrometeorological Agency in the late 1990-ties, but initially it was used only for processing and storage of data gathered from automatic AQ monitoring stations. First modelling exercises began in 2000 – 2001 when digital map of capital of Latvia – Riga city and related GIS databases with regard to emission point sources as well as input meteorology data were prepared. For the moment, digital maps are prepared and point source emission databases are being revised with respect to 9 other industrially more developed Latvian towns, also. Besides, within the framework of joint Latvian - Danish project on assistance to Latvia on implementation of the EU Ambient Air Quality Directive some other AQ models developed by Danish National Environmental Research Institute are being approbated. OML is a regulatory Gaussian model for point sources and OSPM (Operational Street Pollution Model) - street canyon model used in Danish towns.

AQ modelling and monitoring (direct measurements) are complementing each other. Until 1997 air quality analyses in Latvia were based on the so-called "wet chemistry" methods. Since 1998 the observation system is grounded on automatic measuring devices employing the method of differential optical absorption spectroscopy (DOAS). At the present 15 such observation stations manufactured by the Swedish OPSIS AB Company have been placed in 9 largest cities and one rural area of Latvia.

CONCEPT FOR COMPLEX AIR MANAGEMENT SYSTEM

According to the outlined concept (Figure 1) the main elements of the overall air quality management system are sections of **environmental information** (I) (data gathering patterns: monitoring, scientific investigations, statistics, modelling; data processing and storage in databases; reporting: operationally, monthly, annually etc.), **decision making** (II), **raising of environmental awareness** with informing of society and possible involvement of stakeholders (III) as well as different **actions** (IV) to be performed in order to improve or maintain the air quality.

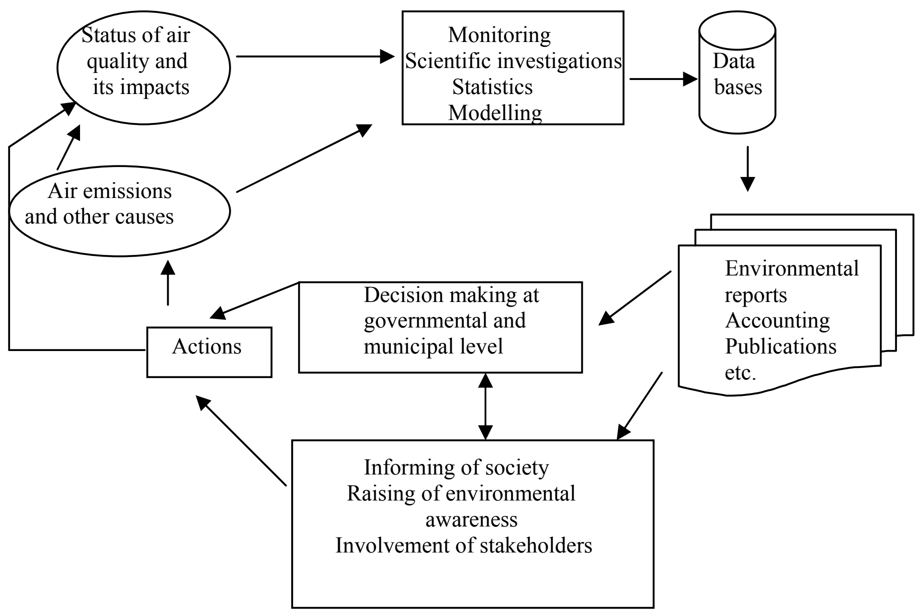

Figure 1. Conceptual air quality management system.

EU Ambient Air Quality Directive (*Anonymous, 1996)* and respective "daughter directives" (*Anonymous, 1999a, 2000a, 2002*) are giving the general framework for nomination of air quality zones in a country serving as management units as well as for EU reporting purposes, as it is clarified in Figure 2.

The starting point for air quality zoning is a preliminary assessment on air quality in the country taking into account all information available, including information generated by modelling. Within the framework of Latvian – Danish cooperation project repeated preliminary assessment on air quality in Latvia is envisaged in 2002.

The actual quality status of adopted air quality zones conditions the further monitoring and assessment patterns – if some pollution levels, namely, the upper and lower assessment thresholds, below the respective limit values set have not been exceeded permanently, more "easy" assessment methods are allowed based on indicative investigations (monitoring) and modelling (*Anonymous, 2000b*).

It should be stressed that the aforementioned targets of a zone are to some extent contradictory: for management purposes it is reasonable to delimit all territories with air quality problems in the country separately, but it is much easer to report to EU on a few zones.

CONCEPT FOR ENVIRONMENTAL MONITORING SYSTEM

Proper monitoring and information system are significant prerequisites for environmental management. A concept for complex air monitoring system as a part of overall environmental monitoring system, consisting of 3 uniform functional blocks, which can be specified detailed,

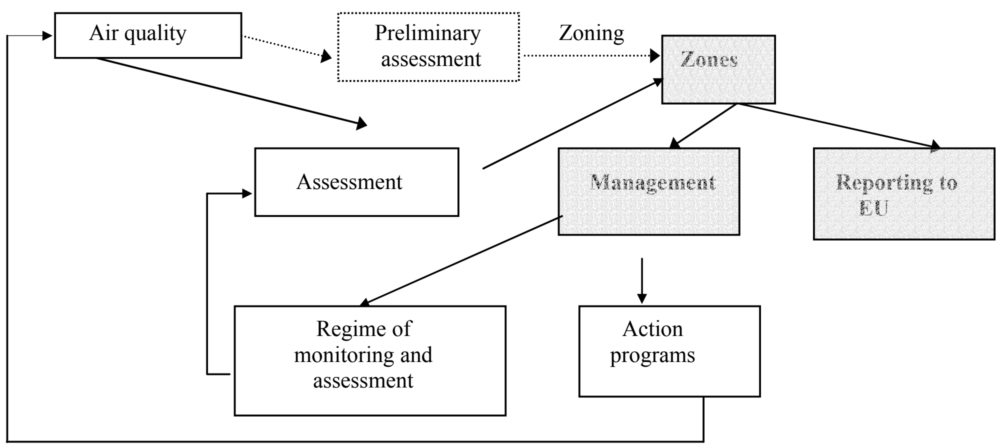

Figure 2. Structure for air quality management and reporting adopted in EU.
------- temporal tasks ________ permanent tasks

has been proposed:

- **Environmental quality monitoring** (1) Monitoring of the pollution distribution and concentration; 2) Monitoring of the status of biocenosys; 3) Monitoring of the physical conditions of environment);
- **Emission monitoring** (1) Monitoring of point sources; 2) Monitoring of non-point sources);
- **Early warning monitoring**.

Different functional types of monitoring have a certain supportive role in AQ modelling – validation of model's calculations, providing input data (for instance, meteorology information as a kind of information on physical conditions of environment and emission data), etc.

Emission monitoring in the country as a key moment for pollution's dispersion modelling have to be improved and EU CORINAIR guidelines for emission estimation must replace emission estimation methods based on empirical algorithms elaborated in Soviet times. Management of emissions from mobile sources actually is at very beginning in Latvia except the capital of Latvia, Riga city.

AIR QUALITY MODELLING STATUS IN LATVIA

At present the development of pollution's dispersion modelling for different purposes in Latvia is associated with the following tools: 1) EnviMan (OPSIS AB Company, Sweden); 2) OML (National Environmental Research Institute, Denmark); 3) OSPM (National Environmental Research Institute, Denmark).

EnviMan modelling package

The EnviMan modelling package consists of Data Management Suite and Geographical Information System (GIS) Suite (*Anonymous, 1999b*). In 2002 the newest Version 2.0 of the modelling program has been installed in the Latvian Hydrometeorological Agency and Environmental Department of Riga City Council.

Data Management Suite comprises the following modules: 1) **ComVisioner** - basic module for data acquisition and validation of measurement data. Also provides a number of functions for data presentation; 2) **IOManager** - a software-based data logger module to be used together with ComVisioner; 3) **Reporter** - a module for advanced statistical analysis of time series of data including numerous functions for data selection, data processing and data presentation; 4) **Sitebuilder** - add-on module to ComVisioner and Reporter, making it possible to automatically publish data on the Internet or Intranet; 5) **Forecaster -** add-on module to ComVisioner in order to provide air quality predictions for the next day. Forecaster requires a user supplied weather forecast (minimum requirement: wind speed, air temperature and cloudiness).

In its turn, *GIS Suite* comprises the following modules: 1) **Mapper** - a set-up tool for importing vector maps and/or raster maps into datasets to be commonly used in all the EnviMan GIS modules. Mapper includes map editing and map creation tools; 2) **Emissioner** - a map based emission inventory and emission simulation tool; 3) **Planner** - simulates air quality utilising dispersion models, map information (Mapper), emission information (Emissioner) and weather data (ComVisioner). Simulations can be set-up for individual sources or multiple sources for forecasting, regulatory studies, planning (what if) scenarios, etc.; 4) **Finder -** finds the location of the major pollution sources in a limited geographical area and estimates their emission rates. Requires input data from measurement stations (both air quality data and weather data).

Input and output data for EnviMan and OML models

Both models are requiring quite similar minimal basic input data generated by monitoring, state statistics and / or special investigations (*Anonymous, 1999b; Berkowicz, R., H.R. Olesen, and P. Lofstrom, 2001*). More sophisticated meteorological data for OML are needed, for example, radiosonde data (air temperature, pressure, relative humidity), relative humidity, cloudiness, etc. As regards output data, OML model provides more enhanced possibilities with respect to data patterns to be obtained (Table 1).

Table 1. Input and output data for EnviMan and OML models assumed as a "black box"

Input data for EnviMan and OML	Output data from EnviMan	Output data from OML
Stationary sources: ▪ location ▪ emissions (t/y) ▪ speed and temperature of emissions ▪ height and diameter of stack **Area sources:** ▪ location ▪ emissions (t/y) **Mobile sources:** ▪ intensity of traffic in relation to a particular street and type of cars ▪ "pollution factors"	1. Period average and extreme for: ▪ Hourly values ▪ 8hourly values ▪ Daily values 2. 90, 95, 97, 98, 99 percentiles	1. Period average and extreme for: ▪ Hourly values ▪ Daily values 2. Monthly averages 3. Yearly averages 4. Winter averages 5. 90, 95, 97, 98, 99 percentiles
Line sources: ▪ characterization of street`s configuration		

Table 1. Input and output data for EnviMan and OML models assumed as a "black box" (continued)

Input data for EnviMan and OML	Output data from EnviMan	Output data from OML
Meteorological data (minimum): ▪ temperature ▪ wind direction and speed ▪ global radiation		

For the moment, the input database is more developed for Riga and Daugavpils (the second largest town of Latvia), where mobile source data and meteodata are available, as well.

Example of modelling exercises

Maximum hourly concentrations of SO_2 in Riga based on emissions from 2000 and modelled by OML are shown in the Figure 3.

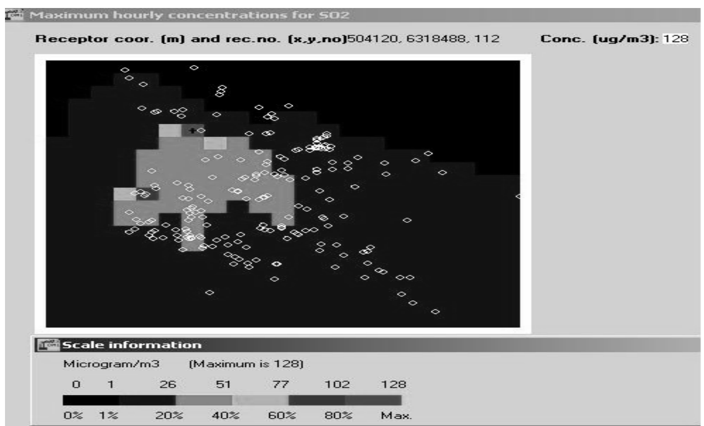

Figure3. Maximum hourly concentrations of SO_2 in Riga modelled by OML.

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