

STUDY CONCERNING THE MONITORING OF ATMOSPHERIC POLLUTION AND IMPLEMENTATION OF RECTIFICATION MEASURES

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ABSTRACT: The paper research regard the system witch is aiming at the development of an informative World Wide Web (WWW) site, which through the Internet would inform the public about aspects concerning the air pollution, the evolution of the air pollution, the meteorological forecast, the air quality monitoring (in real time), the European legislation, provide advise to the public in case of severe episodes, useful phone numbers.

KEYWORDS: monitoring, atmospheric, measures, pollution, pollutants emission, air pollution levels.

1. INTRODUCTION

The system must fulfill the following requirements [1]: have the ability to forecast air pollution levels as well as their spatial and temporal variation, on the basis of meteorological conditions and pollutants emission forecasts; have the ability to estimate the evolution of air pollution levels as a function of short-term structural changes. In this frame, it will be possible to estimate the influence of each one of the major pollutants emission sources on the overall air quality; have the ability to evaluate the impact of specific interventions on the evasion or suppression of air pollution episodes. As a result, the overall evaluation of these interventions will be possible in advance, (i.e. traffic restrictions at the city center, reduction in industrial activities etc.).

The aims are:

- To monitor the atmospheric pollution over.
- To collect and archive all data associated with atmospheric pollution
- Predict episodes of atmospheric pollution in a way that rectification measures can be taken in time.
- Monitor the implementation of the proposed strategy against pollution further aiming at its gradual improvement.

Main and Immediate Objective:

- A better Atmospheric Environment.

2. MATERIALS AND METHODS

Basic functionality of Operational Center (OC) [2].

1. Concentrates and files all atmospheric pollution related data i.e. :
 - Air quality data.
 - Local Weather forecast data.

- Pollution emission data, (from mobile or immovable sources).
 - Social character data.
2. Forecasts levels and incidents of air pollution.
 3. Allows the correlation of filth emission levels and the air pollution ones.
 4. Supports the procedure of definition of the necessary means, for the reduction of emissions from different sources according to the existent or predicted situation of air pollution, aiming to suppress incidents of air pollution.
 5. Supports the evaluation of performance of means against pollution. That is, it allows the estimation of performance for possible interventions towards the reducing of filth emission.
 6. Supports the procedure of scenarios of emergency means, against pollution.
 7. Supports the development of long-term strategy against pollution. In addition, it helps making the strategy better and watching on its efficiency.
 8. Supports the a priori evaluation of influences by the application of community directions and legislative regulations.
 9. Supports the communication with the services that control the decision and application of means against pollution.
 10. Informs the mass media and information providers, about to filth concentration and incident forecasting.
 11. Informs the public
 - Daily, for the air pollution levels
 - On regular time, for the general evolution of air pollution.
 - For the kind and level of restrictive means, that will be applied.
 12. Supplies data to Services and institutions in Greece and EU authorities.
 13. Supports the control of credibility and accuracy of emission filth data, weather observation and local forecast.
 14. Supports the function of different models of forecasting:
 - Statistical models
 - Wind diagnostic models
 - Wind forecast models
 - Photochemical models
 - Lagranzian models
 - CBR (Case-Base Reasoning)
 - ANN (Artificial Neural Networks)
 - DT (Decision Trees)

The OC air pollution episode forecasting system is divided into five subsystems [5]:

E1. Statistical method - Decision Trees (DT) and/or Neutral Networks (NN) technique.

E2. Installation of a prognostic method for the description of wind fields and pollutants dispersion.

E3. Photochemical model installation.

- E4. Application of a synoptic classification system.
- E5. Implementation of the method describing source-receptor relationship on the basis of clustering of wind data.
- E6. A system for decision support and restriction measures taking.
- E7. A system for data base management.
- E8. A system for the support of public informing.

3. RESULTS AND DISCUSSIONS

3.1. Statistical or other relevant methods - Subsystem E1.

Objectives:

The specific subsystem will be applied on an operational basis, the aim being the prompt diagnosis of the probability of an air pollution episode to occur in the Athens basin. This subsystem will not perform detailed prediction.

Input data:

The required input data will be derived from the OC data base and consist of: historical air quality measurements; historical measurements of surface and upper air meteorological data; meteorological forecasts; pollutant emissions data, episode levels definition.

Results:

Subsystem's E1 result must consist of:

- Explicit indication of the possibility of an episode to occur during the forecasting period.
- Forecasting of the height as well as of the spatial distribution of primary pollutant concentration levels.

3.2. Prognostic method for the description of the wind field in combination with an Eulerian dispersion model - Subsystem E2.

Objectives:

The application of one or more prognostic methods on an operational basis is foreseen. The prognostic method must be equivalent to an independent mathematical model system, capable of simulating wind fields and inert pollutants dispersion, calculate air pollution levels for the present situation and, in case air quality standards are exceeded, for all the emissions reduction or emergency response scenarios. The main objective is to define and, eventually, adopt the best scenario among all those examined.

Input data:

This subsystem will be supplied with: local meteorological data (wind fields, temperature, humidity, and pressure). The results consist of prognostic meteorological fields, stored at predetermined periods of time; topography and land use data for the computational domain, their spatial resolution is that of the computational grid, i.e. 2000X2000m; emissions data.

Results:

The results of the present subsystem consist of pollutants concentration fields extracted at specific time intervals (~ one hour), for the selected case and, in case air quality limits are exceeded, for each emissions reduction scenario examined.

3.3. Photochemical dispersion model - Subsystem E3.

Basic objectives:

This subsystem corresponds to a photochemical dispersion model, which will estimate the concentrations of photochemical pollutants, especially of ozone.

The photochemical dispersion model may be applied for ozone levels prediction with a resolution similar to that of subsystem E2 (2000x2000m).

Input data:

The subsystem's requirements focus on: local meteorological data stored at fixed time intervals extracted from the application of a prognostic wind model; topography and land use data for the selected area with a spatial resolution that of the computational grid, i.e. 2000x2000m; emissions data emphasizing on hydrocarbons.

Results:

The results of the present subsystem consist of pollutants concentration fields extracted at fixed time intervals.

3.4. Synoptic classification of air pollution episodes - Subsystem E4.

Objectives:

The percentage of successful forecasts obtained with the use of statistical methods (subsystem E1) can be considerably increased if these methods are combined with the method of synoptic classification.

Input data:

Synoptic weather maps at the surface and at 850, 700 and 500 hPa with a temporal frequency of 6 hours and a recommended duration of three days minimum counting from the reception day. For a period of time not exceeding 72 hours a strong probability of an accurate prediction stands; data deriving from soundings at 02.00 and 14.00 LST.

Results:

The result of the present subsystem is the classification of the forthcoming 24 or 48 hours into a synoptic class.

3.5. Source - receptor relationship method - Subsystem E5.

Objectives:

Preparatory phase: During this phase atmospheric conditions which favor the occurrence of an episode will be classified on the basis of the categorization of the wind data collected by the network of stations installed in the Athens basin. Specifically, this phase involves the following steps [7]:

1. Wind fields classification.
2. Calculation of transfer coefficients for each episode class and each pollutant, through the application of a Langrangian particle model. Registration of transfer coefficients into matrixes.

Operation phase: During this phase and by applying the Case Based Reasoning technique, all available data will be exploited for the definition of the appropriate episode class.

Input data: The input data consist of all measuring campaign observations and the synoptic classification results (subsystem E4). In addition, a diagnostic wind model and a Langrangian particle model must be available.

Results: The result of the preparatory stage is the transfer coefficient matrices for each episode class and each pollutant.

3.6. Decision support subsystems for the selection and implementation of emergency restraining measures - subsystem E6

At present the restraining measures are classified into two steps in terms of concentration levels. This should be modified to a four-step system for the future operation of the OC. The new system must take into account both the concentration levels and the time duration of each event.

Efficiency of measures

In order to evaluate the efficiency of the proposed measures at each emergency measure step, it would be necessary previously to evaluate the contribution to pollution (kind and quantity of pollutants) from each source or activity, which is included in the measures.

Priority criteria for emergency measures

Taking into account the directions set by the local supervising Service the reduction of hydrocarbons is chosen with priority.

In order to evaluate the efficiency of the hydrocarbon emission scenaria, special studies and research to identify contributions from each source must be carried out, because the existing studies can only provide very little or no assistance to that effect.

3.7. Data base management system - Subsystem E7

General Objectives

This subsystem is aiming at gathering all the required data for the operation of the centre. It must also be able to classify the data and answer queries in a fast and efficient way, when such an action is needed. The specifications for a Data Base Management System (DBMS) will be developed in accordance with the recent EEA decisions.

Input Data

The input data are coming from different sources. The main categories in which they fall into are the following:

- Air quality.
- Meteorological data.
- Pollutants emission data, (relevant to the traffic, the industrial emissions, the central heating).
- Law-related parameters, (episode limits according to the Greek, the European, and the world practice, EU rules and guides for the improvement of air quality).
- Elements of social behavior (related to the human activity in the basin during the year, the holidays, the traffic in the center of the capital, etc.).

4. CONCLUSIONS

The available information is intended to make the people more sensitive to these problems and to persuade them to take action towards air quality preservation, represented in figure no. 1.

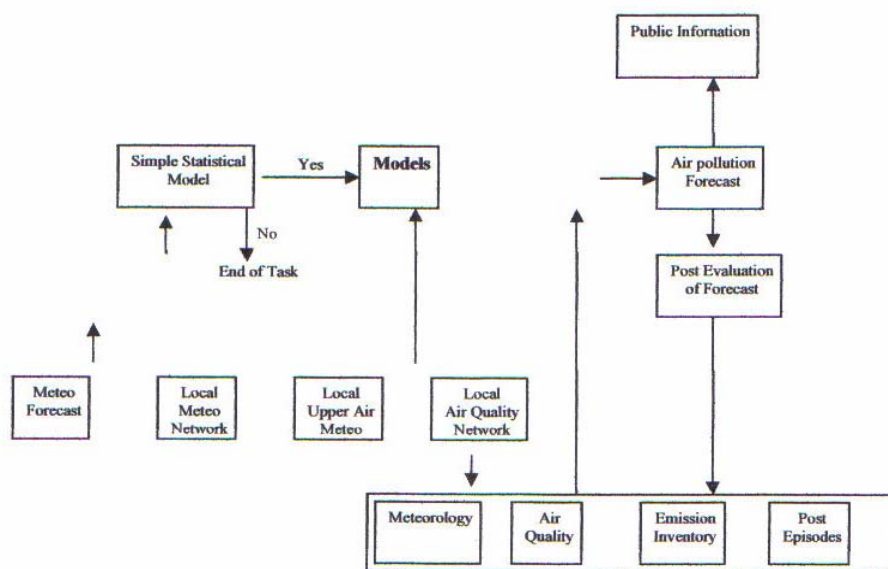


Fig. 1 Aspects concerning the air pollution

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